17668

NATIONAL LIBRARY
OTTAWA

CANADA

BIBLIOTHÈQUE NATIONALE
OTTAWA

L

NAME OF AUTHOR YURIY RIABOV

TITLE OF THESIS PROBLEMS OF TECHNOLOGICAL PROGRESS IN SOVIET INDUSTRY

UNIVERSITY OF ALBERTA (EDMONTON)

DEGREE FOR WHICH THESIS WAS PRESENTED M.A.

YEAR THIS DEGREE GRANTED 1973

Permission is hereby granted to THE NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

(Signed) Y. Riabov

PERMANENT ADDRESS:

EAST EUROPEAN SERVICE
BBC, BUSH HOUSE
LONDON, ENGLAND

DATED 26 September 1973

NL-91 (10-68)

THE UNIVERSITY OF ALBERTA

PROBLEMS OF TECHNOLOGICAL PROGRESS IN SOVIET INDUSTRY

by

Y. RIABOV

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS

DEPARTMENT OF POLITICAL SCIENCE

EDMONTON, ALBERTA

FALL, 1973

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies for acceptance, a thesis entitled . . . .

PROBLEMS OF TECHNOLOGICAL PROGRESS IN SOVIET INDUSTRY . .

submitted by . . . . Y. RIABOV . . . .

in partial fulfillment of the requirements for the degree of Master of Arts.

Ivan L. Rudnytsky
. . . .
Supervisor

. . . .

Ivo Moravcik
. . . .

Date . . . September. 22, . 1973 . .

ABSTRACT

Almost from the very beginning of its existence the Soviet government set a goal of catching up and overtaking the leading capitalist countries economically and technologically and to become so strong military that any attack against the first socialist state would be unrewarding.

The Soviet Union did succeed in becoming a first-class military and economic power and it is now as secure as any country in the world. However, when we look at the commodity structure of international trade between the Soviet Union and the West, we find that vis-a-vis other developed countries it still plays the role of an underdeveloped country: a supplier of raw materials and fuels and a consumer of modern technology.

On the other hand, products of the Soviet defence industry are on approximately the same level as those of the American defence industrie. Thus, we m y observe a very strange paradox: the Soviets are able to produce highly complex and sophisticated equipment but fail to make comparatively simple products. The crux of the matter is that the defence industry absorbs a lion's share of modern equipment, sophisticated materials, and best-trained and capable manpower, thus leaving the rest of the economy with totally inadequate resources.

The reasons for the relative backwardness of Soviet technology are numerous and complex and it is the purpose of this paper to try to determine these reasons and their interrelations.

Chapter I outlines the current state of the Soviet economy, its major problems and why there is such an emphasis on R & D in the country today. Chapter II deals with the R & D policy of the government. Chapter III lists a number of ways of assessing productivity of Soviet R & D and tries to evaluate the reliability of such assessments. The next three chapters, IV, V and VI give descriptions of the Soviet industrial R & D system, its working and its main problems.

The rapid and high quality construction of new plants and expansion and reconstruction of existing enterprises is often required for introduction of new technology into mass production. Chapter VII analyzes the causes of the unsatisfactory situation in the Soviet construction industry, something which is regarded by Soviet experts as one of the main causes of Soviet technological lag. Finally, chapter VIII briefly discusses the problem of Soviet management - another serious obstacle for a more rapid technological development.

The summary presents the major findings of the paper and some speculations on the possible trends in the Soviet R & D policy.

ACKNOWLEDGEMENT

I wish to thank Dr. Moravcik and Dr. Dacks for their help in completing this thesis. However, I especially wish to thank my supervisor Dr. Rudnytsky for his strong support and helpfulness in this undertaking. I would also like to extend my thanks to Dr. Mote and Dr. Engelmann for their helpful comments.

I am indebted to my wife Tamara Riabov for her important contribution and moral support in the production of this thesis.

TABLE OF CONTENTS

PAGE

Chapter I. THE CURRENT STATE OF THE SOVIET ECONOMY 1

A. The Role of Economic Growth in the Soviet Union 1

B. Soviet Achievements in Economic Development 1

C. Specific Problem Areas in Soviet Economy 4

1. Consumer Sector 4

2. Space and Arms Race 6

3. Apriculture 7

4. Labor Problem 9

D. The Growing Complexity of the Soviet Economy 11

1. Inability to Cope Successfully with the Present Soviet Economy 11

2. Economic Reform 12

E. The Current Trend 14

F. Conclusion 15

CHAPTER II. SOVIET R & D POLICY 16

A. The Early Period of Soviet R & D Policy 16

B. Manpower and Finance for R & D 17

1. Rapid Growth in the Number of Scientists in the World 17

2. Soviet R & D Manpower 18

3. Financing R & D in the U.S.S.R. 20

a) Soviet Data 21

b) Difficulties in Assessing Soviet Expenditure on R & D 22

c) Slow Down in the Growth of Soviet Investment in R & D 23

PAGE

4. U.S. Investment in R & D 24

a) Drop in Investments 24

b) Reasons for the Drop 27

5. Soviet R & D Policy in the Light of Soviet - American Rivalry 29

C. Conservatism and Ideological Interference 31

D. Soviet Interest in Modern Foreign Technology 33

1. Purchases from the West 33

2. Co-operation within Comecon 34

E. Switch from Priority System to a More Balanced Technological Development 35

F. Conclusion 37

CHAPTER III. MEASUREMENT OF RETURN ON R & D. 38

A. Introduction 38

B. Problems of Measuring Return on R & D 39

1. Inconsistency of Soviet Data 39

2. Difference in Soviet Assessments of the Return in the USA 40

C. Methods of Measuring Return on R & D 40

1. Nobel Prizes 41

2. Patents and Scientific Papers Presented 41

3. Number of Scientists and Expenditure on R & D 42

4. M. Boretsky's Estimates 42

D. Growth in Labor Productivity as a Yardstick of R & D Influence on Technological Progress 42

E. Conclusion 45

PAGE

CHAPTER IV. SOVIET INDUSTRIAL R & D SYSTEM 46

A. The Main Difference Between Soviet and Western R & D Systems 46

B. Organization of Soviet R & D 47

C. Research Organizations 47

D. Design Organizations 48

E. Ministerial Emphasis on Production and the Consequent Lack of Experimental Facilities 49

F. Slow Introduction of New Technology into Production .. 500.

G. Conclusion 52

CHAPTER V. R & D IN RESEARCH AND DESIGN ORGANIZATIONS 53

A. Separation of R & D Organizations from Plants.......... 53

B. Collaboration Between R & D Organizations and Plants.. 54

C. Barriers Within Economic Administration 57

D. Shortage of Testing and Experimental Facilities 58

E. Financing R & D 59

F. Adverse Effect of Rigid Planning on Creativity in R & D 60

G. Mismanagement 61

H. Payment to R & D Personnel 63

I. Economic Calculations 64

J. Conclusion 67

CHAPTER VI. Plant R & D 69

A. Shortage of Development Facilities 69

B. Pay to R & D Personnel 70

C. Factors Inhibiting a Greater Participation of Plants in Technological Progress 72

1. Production Plan vs. New Technology 72

PAGE

2. Lack of Inventives for Enterprises 74
3. Lack of Incentives for Plant Inventors 75
4. Initiative vs. "Wait and See" 76

D. New Forms of R & D 78
1. Industrial - Production Combines (PPO) 78
2. Production - Technological Combines (PTO) 79
3. Science - Production Combines (NPO) 82
4. Old Diseases in New Organizations 84
5. Intermediate Organizations 88
a) Success of Their Operations. 88
b) Reasons for Closure 90

E. Prices 91
1. Profit as Success Indicator in the Soviet Union and the West 91
2. Price - Setting 92
3. Artificially High Profitability 93
4. Rise in Prices for New Technology Higher than the Rise in Productivity 94

F. Conclusion 96

CHAPTER VII. CONSTRUCTION.............................. 98

A. Importance of Construction for Technological Progress.. 98
B. Unsatisfactory Structure of Investment 98
C. Scattering Resources Over Excessive Numbers of Projects 99
D. Increase in the Number of Unfinished Projects 101
E. New Construction vs. Reconstruction 103
F. Faulty Estimates 106
G. Low Level in Designing 107

PAGE

H. Low Labor Productivity in the Construction Industry 109
I. Misuse of Funds for Industrial Construction 110
J. Regular Underfulfillment of Plans 111
K. Slow Construction - a Brake on Technological Progress .. 114
L. Conclusion 114

CHAPTER VIII. MANAGEMENT 115
A. The Management Problem in Marxist Writings 115
B. Management under Stalin 115
C. Soviet Industrial Management in New Conditions 116
D. Inadequate Training 117
E. Low Prestige of Soviet Managers 118
F. Conclusion 119

SUMMARY 121
BIBLIOGRAPHY 123
APPENDIX I. Industrial R & D 133
APPENDIX II. "Who is a Scientist?" 134
APPENDIX III. Transliteration 135

CHAPTER I

THE CURRENT STATE OF THE SOVIET ECONOMY

A. The Role of Economic Growth in the Soviet Union

Performance of national economy is regarded as one of the major indicators of the success or failure of any government in the West. In the Soviet Union, however, because of a very strong Marxist bias in favor of economics and the determination to become militarily strong and able to meet any external threat the rate of economic growth is regarded as the all-important indicator of the success of the regime and everything else including the welfare of the population has been sacrificied to this end.

B. Soviet Achievements in Economic Development

It is universally acknowledged that the achievements of the Soviet economy from the beginning of the First Five-Year Plan have been very impressive, although the extent of Soviet successes is still a matter of controversy between Soviet claims and Western estimates.

	USSR as % of USA			USSR in 1975 as % of USA in 1970
	1950	1960	1970	
National Income	31	58	65	90
Industrial Output	30	55	75	110
Capital Investment	30	75	100	130
Agricultural Produce	55	75	90	110

Source: N. K. Baibakov (chief ed.), *Gosudarstvennyi piatiletnii plan razvitiia narodnogo khoziaistva SSSR na 1971-1975 gody* (Moskva: Izd-vo politicheskoi literatury, 1972), p. 33.

This table shows that the National Income of the USSR in 1970 was 65 % of that of the United States with industrial output reaching 75 %. On the assumption that the US rates of growth in 1971-1975 will be the same as in the period of 1966-1970, the Soviet planners come to the conclusion that in 1975 Soviet national income will reach 80 % of the American level, industrial production 85 %, while agricultural produce in the USSR will surpass the US level.[1]

However, the Soviet planners come to such conclusions using the concept of the National Income and not the Gross National Product used in the West, and these two are far from being identical.[2]

---

[1] Ibid.

[2] International comparisons of broad aggregates such as "National Income" or industrial output involve many definitional and conceptual difficulties. As far as difinitional problems are concerned, the major one is the fact that the Soviet definition of National Income excludes most services whereas in the West services are included. This means that when the US performance is measured according to Soviet definitions this makes it appear much poorer in relation to the Soviet because the services which are excluded from both US and Soviet measures, play a much greater role in the US than in the Soviet GNP. And conversely when the services are included (that is when both countries performances are measured by GNP) then the Soviet performance will appear relatively weak.

A second major problem of international comparisons is an aspect of the so-called "index-number problem". In particular this means that no single figure accurately describes e.g. the USSR/USA GNP ratio. For a lucid discussion of this question see Abraham S. Becker, "Comparisons of United States and USSR National Output," World Politics, XIII (October, 1960), pp. 99-111.

The wide-spread belief in the West is that Soviet GNP is about 50 % of the US GNP.[1] Despite the difference in the assessments of the relative performance of Soviet economy both sides agree that its growth is decelerating.[2] This situation caused Premier N. Kosygin to severely criticize the sluggish performance of the national economy.[3]

According to official statistics, the annual rate of growth of industrial production was some 12 % by the end of 1950's but in the last few years it was only about 7 %, which is much smaller than Japan's rate of industrial and economic expansion. According to calculations made by some economists, if the present trend is to continue, then Japan could overtake the Soviet Union in GNP by 1985. For the country that prided itself on the highest rate of economic growth as a proof of the superiority of its economic system this prediction has serious ramifications.

---

[1] U.S. Congress, Joint Economic Committee, Economic Performance and the Military Burden in the Soviet Union, 91st. Cong., 2nd sess., 1970, p. 13.

[2] Abram Bergson, "Toward a New Growth Model," Problems of Communism, XXII (March-April, 1973), pp. 1-9.

[3] "Rezervy na sluzhbu proizvodstvu," Planovoe khoziaistvo (No. 11, 1972), pp. 3-8.

C. Specific Problem Areas in Soviet Economy

The main blame for the slow down is put on the inability of the existing economic system to cope with greater commitments and greater complexity of the national economy. As the economic aspect of the general liberalization of Soviet life in the post-Stalin era, greater heed has been paid to consumer welfare without any commensurate diminution in the resource demands of the two traditional priority claimants - defence and economic growth.

1. Consumer Sector

The dollar value of Soviet GNP - before the 1971 dollar devaluation - was about one half of the US level. The Soviet Union occupies a strong second position among the economies of the world with its GNP above half of the US level, some 2-1/3 times the size of Japan, the economy in third position.[1] In per capita terms the Soviet position is relatively lower, with a level of some 40 % that of the United States and about two-thirds of the major economies of North Western Europe.[2] Within reasonable margins of error, per capita GNP of the USSR is about matched by those of Italy and Japan.[3] However, due to the high proportions of GNP allocated to investment and defence, the actual level of personal consumption or the standard of living is well below those of other industrial countries. This discrepancy between the economic and military power on one hand and the low standard of living on the other has become embarrassing and the Soviet government has had to transfer resources to agriculture, housing and consumer goods industries and to devote a smaller proportion of total investment to the "growth-inducing" producer goods' industries. The reasons for this development were not only the natural desire of a government to improve the lot of its people, but also a healthy apprehension that further neglect of human needs could provoke violent outbursts, as had already happened in the 1960-s in various parts of the country, usually connected with food, money and housing situation.

---

[1] U.S. Congress, Joint Economic Committee, Economic Performance and the Military Burden in the Soviet Union, p. 13

[2] *Ibid.*

[3] *Ibid.*

In the past few years the Soviet consumer sector received a greater proportion of investment than the economy as a whole. This trend is even more evident in the current Ninth Five-Year Plan. Under this plan the increase in investment for agriculture is 70 %, for meat and dairy industry 60 %, for light industry 90 %, for tractor and agricultural machine-building industry - double; for light and food machine-building industry - three times; and in services - double. All this against the overall increase in investment for the economy 36-40 %.[1]

---

[1] Y. A. Belik, Ekonomika SSSR v deviatoi piatiletke (Moskva: Izd-vo "Znanie," 1971), p. 49.

2. Space and Arms Race

At the same time the cost of the arms race has soared in recent years, particularly the development and production of supersonic aircraft and missiles, which equal those of the United States in performance. In the space program the Soviet Union did not slacken exploration programs. The anti-space exploration sentiments have been circulating in the USSR as long as in the United States, but they have hardly been given a chance to be aired in public. Poverty, inadequate housing and other economic and social problems exist in both countries, but unlike their American colleagues the Soviet scientists have been more successful in defending the continuation of their programs of extensive space exploration.

The continuing tension between the Soviet Union and China and the failure of all Soviet attempts to solve their differences has forced the Soviet government to accept a pessimistic view about the prospects of Soviet - Chinese relations and to take extra measures to strengthen its military capabilities with a corresponding burden on its resources. With the Chinese economic and military potential developing along the Soviet lines, this burden is likely to grow all the time. The rise of Japan is another factor that cannot be ignored by the Soviet government.

The defence and space sectors have tended to absorb advanced equipment, sophisticated materials and highly trained manpower. The pressure from the consumer sector on the one hand and military and space sectors on the other have placed a considerable strain on resources.

3. Agriculture

Soviet agriculture is the weakest sector of the national economy - this is axiomatic in any discussion on the state of Soviet economy. Stalin's successors took certain measures to improve the deplorable state of Soviet agriculture. However, these efforts have been only partially successful. Soviet agriculture employs five times more people than American agriculture, and yet it produces less. It is not surprising, for each worker in agriculture there are 10 H.P. in the USSR against 78 H.P. for the USA.[1] According to the statement made recently by US Commerce Secretary Peter Peterson, labor productivity of Soviet agricultural worker is only 11 % of that of US agricultural worker.[2]

How far things are from being satisfactory has been shown by the crop failure of 1972. All food producers in the Western world are affected by weather changes, but none of them to such an extent as producers in the Soviet Union. Because of the disastrous results of 1972 for Soviet agriculture, the Soviet government had to import the largest amount of foodstuff in Russian history - more than $ 2 billion worth from the United States and other countries.

---

[1] A. Klinskii and N. Oznobin, "Intensifikatsiia obshchestvennogo proizvodstva," Voprosy ekonomiki (No. 6, 1971), pp. 27-38.

[2] The Voice of America, October 22, 1972.

In his interview to an American correspondent in Moscow the Minister of Agriculture Matskevich stated that if there was a mediocre year in the remaining years of the current Five-Year Plan then the plan could not be fulfilled.[3]

The crop failure of 1972 is likely to strengthen the position of that section of Soviet leadership that has for long advocated much greater attention to agriculture. A drastic improvement in the performance of agriculture is necessary not only for the improvement in the standard of living but also for the production of a greater amount and greater variety of food and other consumer goods for the people. Already by the end of 1941 there were great difficulties with providing a sufficient amount of food to the soldiers, let alone for the civilian population. Of all the supplies sent to the Soviet Union by its Western allies during the Second World War, the food supply was perhaps the most valuable. Improvement of agriculture and making the country self-sufficient in foodstuffs will undoubtedly strengthen Soviet military capabilities and this is the argument the Soviet agricultural lobby is likely to use in trying to re-direct some of the planned allocation for defence to the agricultural sector.

In their argument with the champions of greater investments into industry, the agricultural lobby will point out that periodical failures in the agricultural sector affect Soviet industry adversely and hamper its program of modernization and computerization, since

---

[1] The Voice of America, October 4, 1972.

large amounts of hard currency, of which the Soviet Union is always short, have to be spent for purchasing agricultural produce, thus denying industry of many kinds of advanced Western technology in which they are so interested. Finally, it is disadvantageous when the outside world sees the Soviet agricultural methods in distress. According to some reports 20 billion rubles have been taken from the projected budgets of other ministries for the year 1972-1973 and have been applied to the agricultural sector and to industries related to it.[1]

The appointment of Polianskii, a long-standing Politburo member, as the Minister of Agriculture can be interpreted as an indication of the earnestness with which the Soviet leaders are now seeking remedies for the crisis.

4. Labor Problem

Unitl recently, especially during the years of rapid industrialisation and the first years of the post-World War II economic development, economic growth was achieved mainly on the basis of extensive factors. A decisive role in the rates and scales of economic development of the USSR was played by the continuous and rapid increase in the number of people in industry and high rates of capital investment, which was possible owing to the very large surplus of rural population and the imposed low consumption. At the same time the same factors held back modernization of Soviet economy.

---

[1] "Soviet Bolster Agriculutre," Edmonton Journal, October 23, 1972, p. 53

[2] Dev Murarka, 'More Heads to Roll in Russian Farm Crisis," The Observer, February 4, 1973, p. 5

A better realisation of the benefits of a more rapid technological advance as well as a necessity caused by the rapid drying up of labor reserves and the growing pressure from the consumer have forced the Soviet government to switch from extensive to intensive factors of economic growth. Certain restrictions will be placed on further rates of growth on investment in all branches of the economy.[1]

As for the manpower problem, it is becoming increasingly serious. At present some 92 % of all the able-bodied adult population are employed in the economy. At the beginning of industrialisation the proportion of the population engaged in agriculture was 80 % of the total number of people in the economy, today this figure dropped to 29 %; at the same time in the Centre, North-West, the Urals, Far East where shortage of labor is particularly acute, this proportion is even lower: 10 to 15 %.[2] The situation is bound to become even more serious, because of the dropping birth rate. In 1961 the natural increase in population was 1.84 %, in 1971 it dropped to 0.91 %.[3] The forecast for the future: 1 % maximum.[1] On the other hand the proportion of people employed in non-productive sectors is steadily growing: 20.1 % in 1965 and 22.6 % in 1975. By 1975 this proportion should reach 25 %.[2]

---

[1] S. Sitarian, "Nekotorye finansovye problemy IX piatiletki," Finansy SSSR (No. 7, 1971), pp. 11-20.

[2] F. Kotov, "Aktual'nye problemy deviatoi piatiletki," Voprosy ekonomiki (No. 4, 1971), pp. 31-44.

[3] K. Vermishev, "Stimulirovanie rosta naseleniia," Planovoe khoziaistvo (No. 12, 1972), pp. 102-107.

With the standard of living growing and more living space, more and more women will try to stay and to look after their homes. Therefore, manpower is becoming a limiting factor in the development of Soviet economy and hence the need for more rapid modernization, if the economy is to maintain the existing rates of growth.

D. The Growing Complexity of Soviet Economy

1. Inability to Cope Successfully with the Present Soviet Economy

There is ample evidence that the old organization pattern of centralized direction of the economy, worked out during the first Five-Year Plan, has become increasingly outdated as the claims on resources have multiplied and the technology of production has become more complex. A change in the old development strategy requires a change in economic organization. The sharp decline in the rate of increase in the combined productivity of manpower and capital testifies to the decreasing efficiency of centralized, micro-economic planning.

---

[1] E. Gorbunov, "Tempy, uroven' i struktura proizvodstva SSSR," Voprosy ekonomiki (No. 3, 1971), pp. 41-51.

[2] G. Zelenskii and E. Voronin, "Trudovye resursy v deviatoi piatiletke," Planovoe khoziaistvo (No. 8, 1971), pp. 26-36.

The majority of Soviet leaders and economists agree that the command economy with its principal reliance on production directives from above, implemented by success criteria for production managers and feed back to central planners has proved too cumbersome to be effective in today's complex economy. "According to calculations made by V. M. Glushkov, Direktor of the Institute of Cybernetics of the Academy of Sciences of the Ukrainian SSR, the preservation of the existing system of economic planning and management until 1980 will require the employment of the entire adult population of the nation in these activities."[1]

2. Economic Reform

Soon after Stalin's death a lively discussion developed in the Soviet press on the problems confronting the national economy and what was to be done about them. A number of economists suggested strengthening the authority of industrial managers so that the production of various types of goods would be determined not by central directives but through the interactions of sellers and buyers. At higher levels, automatic economic indicators would be substituted for centrally determined production directives. The more dynamic Soviet economists increasingly recognize that only much more decentralized decision-making can reverse the worsening efficiency trend. They argue that the enterprise should be freed from the necessity of obeying detailed directives, that it should develop much more initiative in formulating productive marketing decisions on the basis of information reflecting more accurately the scarcity relationship in the economy than the centrally fixed prices. Ultimately, some Soviet economists are looking toward a socialist market economy.

---

[1] Richard W. Judy, "Information, Control and Soviet Economic Management" in John P. Hardt et al. Mathematics and Computers in Soviet Economic Planning (New Haven: Yale University Press, 1967), p. 16.

The Soviet economic structure is well designed for the attainment of a limited number of relatively well-defined goals. However, as the range of choice increases for any decision maker, it becomes more difficult to make sure that commands will really control his behaviour in conformance with central priorities. The more interdependence there is among economic decisions, the more difficult it becomes to give decision makers the kind of information and rules for choice that will guide them to rational decisions.

The best-known representative of this line of economic thought was Professor E. Liberman. He proposes that profit criteria be substituted for the cumbersome gross output success indicators for plant managers, that a modified system of direct contractual relations between producing and consuming enterprises be substituted for centralized manterials allocation, and that a capital charge be introduced on investment funds. Essentail features of the command economy which remain untouched by Liberman are the arbitary price system and centralized allocation of most material funds.[1] These proposals were largely adopted in somewhat modified form in the economic reforms of 1965. They represent a limited accommodation by the regime to proposals of organizational reform. The basic contradiction between free contractual relations and administrative allocation of material inputs has been resolved in favor of the latter.

---

[1] This part of the discussion is based on Alec Nove, The Soviet Economy (New York: Frederick A. Praeger Inc. Publishers, 1969), pp. 261-264.

The reforms which have been promulgated represent only a piecemeal and far from complete response to the needs of efficiency. But even these modest measures have run into stiff resistance from well-entrenched bureaucracy. Furthermore, the Soviet leadership is too aware that any far-reaching economic reforms are impossible without corresponding changes on a political level. Demands for radical economic reforms were one of the main reasons for the development of the so-called "Prague spring" in Czechoslovakia in 1968, and the Soviet government has drawn appropriate conclusions from that lesson.

E. The Current Trend

With any meaningful economic reforms blocked for political reasons, a shrinking pool of labor reserves, a lower rate of growth of GNP means a relative decline in the ability of the USSR to utilize its resources efficiently and fewer additional resources made available to the system at a time when its commitments have been extended. In these circumstances the only way that is left open for continued rapid economic development is a greater emphasis on R & D and management. It is universally acknowledged in the USSR that management is a major weakness of the national economy. However, very little has been done to remedy the situation. The manager is still regarded in the Soviet Union as one who dutifully carries out orders (see chapter VIII).

The area where the genuine efforts are being made is R & D, where the Soviet government hopes that generous spending on the work of scientists and engineers will offset weaknesses elsewhere.

F. Conclusion

The Soviet Union has achieved very good results in its economic development since the beginning of the First Five-Year Plan. She has achieved one of its main goals - military security as far as any country can achieve this in present circumstances, but the other main goal - to become the leading economic and technological power in the world has not been attained because the old techniques of running the economy that secured very high rates of growth in the past prove to be far less effective instrument for the present-day highly complicated Soviet economy. This combined with a very heavy military burden, persistent troubles with agriculture, shrinking pool of labor reserves, greater share than ever of resources directed for consumption as well as the vigor of US economy, has made the goal of catching up and overtaking the United States unattainable. In these circumstances, R & D is now regarded by the Soviet government as the area where the outcome of Soviet-American economic competition will be decided.

CHAPTER II

SOVIET R & D POLICY

A. The Early Period of Soviet R & D Policy

One of the reasons for the high priority afforded to science and technology from the very beginning of the Soviet State was the great reverence of V. I. Lenin for modern technology and its impact on the development of society. Throughout his writings, from his first works to the last he dwells at length on the role of technology. This undoubtedly has influenced the thinking of the Soviet governments. Lenin's high appreciation of the importance of modern technology helped him to overcome the resistance of some of his more dogmatic colleagues who strongly objected to the invitation of foreign firms, technical experts, and engineers to participate in the reconstruction and development of the Soviet economy. The massive brain-drain that occured after the October revolution made this policy inevitable.

Anthony C. Sutton gives an impressive list of technical transfers to the Soviet economy in 1917 - 1945 period. The penetration of this technology was complete. At least 95 % of the industrial structure received this assistance.[1] No major technology or major plant under construction between 1930 and 1945 has been identified as a purely Soviet effort.[1] Acquisition of capacity and knowledge was slow and painful. There were major production and quality problems; there were problems with unskilled labor; machinery was abused; and the concept of rigid central planning may itself have been contra-developmental. On the other hand, it is to Soviet credit that they recognized the potent force of technology, identified its origins and ruthlessly harnessed it to their own programs. A conscious attempt to control the development of science and technology and to bring about rapid technical progress was built into Soviet planning at the very beginning.

---

[1] Anthony C. Sutton, Western Technology and Soviet Economic Development, 1917 to 1930 (Stanford: Hoover Institution, 1968), pp. 347-348.

B. Manpower and Finance for R & D

1. Rapid Growth in the Number of Scientists in the World

The indicators most commonly associated with the government's assessment of the role of a particular field of human activity are the number of people involved and financial costs.

Throughout the world, the number of scientists is growing at a continuous and rapid pace. As regards to investment growth rate, science probably has no peer in any sphere of human activity. According to Academician A. Rumiantsev, at the beginning of the 20th century, no more than 15,000 persons throughout the world were directly engaged in advancing knowledge through research activity. By the midfifties, at least 400,000 persons in the world were actively engaged in R & D.[1] By 1967 the total number of scientists was around the 3 million mark.[2] If one includes support personnel too, then the actual figure is three to four times higher.[3]

---

[1] Anthony C. Sutton, Western Technology and Soviet Economic Development, 1930-1945 (Stanford: Hoover Institution, 19710, p. 346.

2. Soviet R & D Manpower

The USSR had 162,500 scientists in 1950, but in 1971 their number was already at 1,002,900[4] working in 5,307 scientific establishments.[5] Of 1,002,900 scientists, 26,100 held doctoral degrees and

---

[1] A. Rumiantsev, "Problemy nauchnogo i tekhnologicheskogo progressa," Voprosy ekonomiki (No. 1, 1971), pp. 3-14. What is or was the actual number of scientists depends on the definition who is a scientist. Rumiantsev's figures conflict with Soviet statistics on the number of scientists in Russia in 1913, put at 11,600. My i planeta (Moskva: Izd-vo politicheskoi literatury, 1972), p. 237. There are no reasons to believe that Soviet statistics would inflate the achievements of pre-revolutionary Russia, and that the growth in the number of scientists at the beginning of this century was not so great. UNESCO Yearbook, 1971 creates even more confusion in trying to asses the number of scientists in the world and in each country. It puts the number of scientists in the USSR at 927,709 (1970), and 62,100 (1969) in the USA. The difference is too great to be plausible. Even in Japan the number of scientists was stated as being nearly four times higher than in the USA. UNESCO, Statistical Yearbook, 1971, p. 598.

[2] G. M. Dobrov, Potentsial nauki (Kiev: Izd-vo "Naukova dumka", 1969), p. 21.

[3] Ibid.

[4] Narodnoe khoziaistvo SSSR, 1922-1972 (Moskva: Izd-vo "Statistika", 1972), p. 103.

[5] Ibid.

249,200 candidate degrees.[1]

If one takes into account that the ratio of scientists to support personnel in Soviet R & D sector is 1:3[2], then the total number of people engaged in Soviet science is around four million. Soviet statistics claims that Soviet scientists make up a quarter of the totatl number of scientists in the world.[3]

However impressive these figures are, no country in the world can sustain this rate of growth in the number of people engaged in research and development for a prolonged period of time.[4]

---

[1] Ibid.

[2] K. L. Gorfman, N. I. Komkov, and L. E. Mindeli, Planirovanie i upravlenie nauchnymi issledovaniiami (Moskva: Izd-vo "Nauka", 1971), p. 151.

[3] Narodnoe khoziaistvo SSSR, 1922-1972, p. 103.

[4] If we assume that doubling in the number of this category occurs in every 10 years, we would find that for the Soviet Union the perspective of the whole adult population working in R & D is not remote. G. N. Volkov thinks that this would happen in the 22nd century and regards such a situation as perfectly normal for the "scientific civilization of the future". G. M. Volkov, Sotsiologiia nauki (Moskva: Izd-vo politicheskoi literatury, 1968), pp. 153-154. This view is not shared by others. If we take 1967 as the base year the doubling in the number of scientists and support personnel every 10 years would have put the USSR in 70 years in a situation where it would have 380 - 400 million people working in R & D sector (90 - 100 million scientists). This is the whole population of the country at that time. Therefore, Volkov's "scientific civilization" would come in the first half of the 21st century, not in the middle of the 22nd century. If one continues this extrapolation the year of 2067 would witness the presence of 3 billion people engaged in research with some 800 million scientists among them. This is well in excess of the expected total population of the country. Problemy deiatelnosti uchenogo i nauchnykh kollektivov (Leningrad: Izd-vo "Nauka", 1969), p. 18.

This was one of the main reasons for the current slow-down in the increase in the number of scientists in the USSR, as well as in the USA. While in the period of 1960-1965 the number of scientists in the USSR rose by 87.6 %, the increase for 1965-1970 was only 39.7 %. Thus, according to the official Soviet data, the rate of growth of R & D manpower in the 1965-1970 period was under half the average of the previous five years. The change in the United States is reported to have been even greater. Some 100,000 scientists, engineers and technicians are estimated to be unemployed.[1]

3. Financing R & D in the USSR

The second customary yardstick for the measurement of the R & D effort is the amount of money expended for research and development. In theory this yardstick provides, as it were, a single measure of all resources employed in R & D activities: a single aggregate valuation, which includes the salaries of research scientists and supporting personnel and other operating and capital expenses.

Even when detailed fiscal accounts of the government are available, as it is the case with the United States, there are numerous practical and conceptual difficulties in arriving at an objectively supportable summation of the R & D expenditure. Special limitations and uncertainties necessarily arise whenever one deals with Soviet fiscal accounting.

---

[1] L. Lessing, "Why the U.S.A. Lags in Technology," Fortune LXXXV (No. 4, 1972), pp. 69-73.

a) Soviet Data

The Soviet expenditure on R & D or "science" as they prefer to call it, is the fastest growing among all sectors of the economy. Within 20 years, from 1950 to 1970, total spending on R & D rose from 1 to 11.7 billion rubles.[1] In 1971 this figure rose to 13 billion,[2] and in 1972 to 14.4 billion rubles or about 5 % of the National Income.[3]

If one converts Soviet expenditure figures in 1972 for R & D on the basis of the official rate of exchange (1 dollar = 0.829 rubles, after the 1971 dollar devaluation), the result is 12 billion dollars. Within the devaluation factor, the figure would have been 1 billion higher - 13 billion dollars (1 dollar = 0.90 rubles). This is well below the current US expenditure on R & D - 27 billion dollars.

This figure would have seemed plausible if one accepts the Western views that the Soviet Union operates from the GNP that is about one half of that of the US GNP and that both countries devote about the same share to R & D - some 3 % of their GNP.[4]

---

[1] Narodnoe khoziaistvo SSSR v 1970 g (Moskva: Izd-vo "Statistika", 1971), p. 732.

[2] V. Pavliuchenko and S. Pirogov, "Nauchno-tekhnicheskii progress i effektivnost' proizvodstva," Voprosy ekonomiki (No. 1, 1971), pp. 109-120.

[3] K. Efimov, "Puti uskoreniia nauchno-tekhnicheskogo progressa," Voprosy ekonomiki (No. 4, 1972), pp. 47-58.

[4] See, for example M. Sami Kassem, Harvey Maertin, and John S. Efroymson, "Soviet and American Policies on Science and Technology," Studies on the Soviet Union, XI (No. 3, 1971), pp. 67-82.

b) Difficulties in Assessing Soviet Expenditure on R & D

However, as an absolute measure of the R & D effort, aside from the problem of definitions and concepts, the Soviet official rate of exchange is not acceptable for comparative purposes, because of the basis of Soviet pricing policy and price structure, which does not reflect the relative scarcity of a particular resource. The utility of Soviet R & D expenditure statistics as a means of comparing the magnitude of Soviet R & D effort with that of other countries is questionable. The fact that Soviet fiscal and monetary structure and economic accounting generally are not commensurable with those of market or mixed economies makes the problem of comparison extremely difficult.

One of the most widely used rates of ruble-dollar conversion for R & D is $ 2.5 - 3.5 : 1 ruble.[1] This would give, as a somewhat conservative estimate for Soviet expenditure on R & D in 1972, a figure roughly in the range of 36 to 50.4 billion dollars, much higher than in the USA, and a heavy commitment for the weaker Soviet economy.

Soviet experts, however, do not accept the Western "research exchange rate." They continue to operate either with the official rate of exchange, or only slightly differently. V. G. Lebedev in his estimation of relative expenditure on R & D puts one ruble as having the same purchasing power as one dollar.[2] He also cities the dollar-ruble ratio of 0.7 : 1 suggested by J. B. Kvasha for estimation of investment.[1] (Both estimations were made before the dollar devaluation.) On the basis of these ratios Lebedev comes to the conclusion that the Soviet investment in R & D is approximately one half of that of the United States per a unit of capital investment. (Capital investment for both countries is assessed as being about equal).[2] A. S. Tolkachev also maintains that Soviet spending in R & D is still less than one half of that of the United States in terms of its share of National Income.[3] These conclusions produce the following statement by Academician A. Rumiantsev:

---

[1] Ibid.

[2] V. G. Lebedev, Narodnokhziaistvennaia effektivnost' razvitiia tekhniki (Moskva: Izd-vo "Mysl'," 1971), p. 251.

> As to our country, we are still lagging behind the USA in the absolute volume of investment in R & D and in the absolute increase of this investment. At present there is no suggestion that we reduce the growth rate of allocations for scientific research.[4]

c) Slow Down in the Growth of the Soviet Investment Rate in R & D

In spite of the undiminished emphasis on the importance of science and technology it is significant that in the Soviet Union, as in the United States, the rate of growth of resources allocated for R & D has tended to decline. If for 1955 - 1965 the average annual increase in R & D spending was 15 %, then for 1965 - 1970 it fell to 9.2 %.[1]

---

[1] *Ibid.*

[2] *Ibid.*

[3] A. S. Tolkachev, *Ekonomicheskie problemy material'no-tekhnicheskoi bazy kommunizma v SSSR* (Moskva: Izd-vo "Mysl'", 1971) p. 104.

[4] Rumiantsev.

However, if the periods 1960 - 1965 and 1965 - 1970 are considered, the fall is far less dramatic: 77 and 69.6 % respectively. (Computed from Narodnoe khoziaistvo SSSR v 1970 g.)

Years		%
1960 - 1965	=	77.6
1965 - 1970	=	69.6
1970 - 1975	=	60 (planned)

60 % increase of expenditure for R & D is planned under the current five-year plan.[2] The rates for 1971 and 1972 were 11.1 % and 10.8 % respectively. It is difficult to say at present whether the planned substantial reduction in the expenditure growth rate on R & D for 1973 (7.2 %)[3] is the beginning of drastic trimming of R & D budget or whether it is simply a shouldering by R & D the consequences of the bad year of 1972 for the national economy.

4. US Investments in R & D

a) Drop in Investments

The table below indicates that both the United States and the Soviet Union were spending about the same proportion of their GNP for

---

[1] Lebedev, p. 252.

[2] Baibakov, p. 26.

[3] P. Kashutin, "Sodruzhestvo nauki i proizvodstva," Ekonomicheskaia gazeta (No. 52, 1972), p. 15.

R & D in the mid-1960's. 1967 marked the beginning in the reassessment of future American R & D policy.

Research and Development Expenditure
(As a Percent of GNP)

	USSR	USA
1951	1.0	1.0
1952	1.0	-
1953	1.1	1.4
1954	1.1	1.5
1955	1.2	1.6
1956	1.3	2.1
1957	1.5	2.3
1958	1.6	2.5
1959	1.7	2.6
1960	1.9	2.8
1961	2.1	2.8
1962	2.2	2.8
1963	-	2.9
1964	-	3.0
1965	-	3.0
1966	-	3.0
1967		2.9
1968	-	2.9
1969	-	2.8

Source: M. Sami Kassem, Harvey Maertin, and John S. Efroymson, "Soviet and American Policies on Science and Technology," Studies on the Soviet Union, XI (No. 3, 1971), pp. 67-82.

The rapid growth in federal R & D expenditure since the beginning of World War II seems to have peaked, and R & D is no longer regarded as the sacred cow when it comes to appropriating funds. The social desirability of much of the research and development expenditure is being re-evaluated, not only by the public but by an increasingly budget-conscious Congress.[1]

Recent trends in R & D financing in the United States present a backdrop in public policy decision-making. The following three facts are extremely revealing:

---

[1] Thomas P. Murphy, Geopolitics and Federal Spending (Toronto: D. C. Heath and Company, 1971), p. 13.

i) The growth rate of total R & D spending in the United States, government and non-government, has been slowing down substantially. From an average rise of almost 14 % a year in the late 1950's the growth rate fell to 9 % in the early 1960's and to less than 5 % in the late 1969's.[1]

ii) When R & D figures are adjusted for inflation, the slow-down in effective national R & D funding is even greater. From an average real rise of 11 % in the late 1950's the growth fell to 7 % in the early 1960's and to three-tenths of one per cent a year for the last five years.[2]

iii) Since 1964, the United States has been investing an ever smaller share of its national resources in R & D.[3]

In view of this trend and the current total American R & D budget of 27 billion dollars, recent Soviet predictions on American spending in 1970's - 36.4 billion dollars for 1973,[4] and 50 billion dollars for 1980[1] - seem to be totally unrealistic.

---

[1] Murray L. Weidenbaum and Dan Larkins, The Federal Budget for 1973 (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1972), p. 16.

[2] Ibid.

[3] Ibid.

[4] G. M. Moissenko, "Nauchno-tekhnicheskaia intelligentsia v sovremennom kapitalisticheskom obshchestve," Voprosy filosofii (No. 12, 1971), pp. 43-54.

Just a few years ago some Soviet authors suggested that the share of National Income devoted to R & D had the optimum limit of some 5 %.[2]

This goal was achieved in the USSR in 1972[3] and on the basis of the current Five-Year Plan this share is to be increased, while the United States drops out of the R & D expenditure race.

b) Reasons for the Drop

No single explanation is sufficient to explain this change in the race. However, some considerations are as follows: First, in the United States, many social critics and conservationists have made science, technology and economic growth intellectually dirty words for a significant part of the public, especially young people. They point out that with all their advances, science and technology have not been able to eliminate social and economic inadequacies of American society. The experience of the Vietnam war has shown that even the latest breakthroughs in military technology have been helpless to move the course of the hostilities in the favourable direction for the American - South Vietnamese side when confronted with other factors of the war. Hence the difficulties with obtaining more funds for R & D and attracting bright young people to work in these areas.

---

[1] Lebedev, p. 242

[2] P. A. Rachkov, "Problemy effektivnosti nauki v sovremmenyi period," Voprosy filosofii (No. 5, 1966), pp. 14-24.

[3] Efimov.

Second, the widespread pollution of air, water, and land in the USA is often regarded - largely unfairly - as the consequence of scientific activity. In the view of many people, to curb science means to curb pollution.

Third, the panic caused by the launching of Sputnik in October 1957 and Gagarin's space flight in April 1961 has largely evaporated. The United States beat the Soviet Union in the moon race. Mooon landings and space flights have become a routine and do not cause nearly as much excitement as the first moon landing. All this contributed heavily in trimming space exploration that was the leader of R & D expansion in mid-1960's.

The fourth is the newly accepted belief that the USA could live with nuclear and general military parity with the USSR instead of trying to retain overwhelming military superiority over its main challenger in the power-game; this helped to moderate American efforts in R & D.

And finally, this moderation has been reinforced by a better realisation that the USSR, although a serious challenger in the arms race, is still far behind the West in the whole range of scientific and technological advances, despite its greater efforts.

5. Soviet R & D Policy in the Light of Soviet-American Rivalry

The picture of R & D policy on the Soviet side looks very much different. Here is no sign of a dramatic change in R & D investment. Some reasons for this are discussed below. Soviet "America-watchers" tend to be somewhat behind in their assessment of current developments in the USA. The drastic cuts in US expenditure have not yet been reflected in Soviet publications. The re-examination of the situation is likely to come soon.

The Soviet government has not been forced to adapt its policies to public pressure to the extent that is evident in the USA. The Soviet Union has also to cope with numerous social and economic problems, but owing to a firm hold on the domestic situation, popular outbursts of indignation have been far less numerous, and, they have not been reported or discussed in public, thus not affecting Soviet decision makers nearly as much as their American colleagues.

In spite of serious pollution problem, recently universally admitted in the Soviet press and in the pronoucements of the Party and the government, the outcry of environmentalists is much more muted in the Soviet Union. It is very well known that, left to themselves, government and industry would do not nearly as much as they do under the pressure of public opinion. Unfortunately for the Soviet environment, the Soviet government assumes the role of the representative of public opinion too. In any clash of interests between production plan and protection of environment the former usually comes out on the top. Therefore the Soviet government is not under heavy pressure to direct more resources for the environmental programs.

Soviet scientists and engineers enjoy the highest social status and respect in Soviet society and this is as high today as ever, and it would appear that they have better hearing from Soviet leadership than their American colleagues from their government.

Soviet science benefits from the "guilty conscience" of the Communist Party. The lessons of the sorry stories of genetics, cybernetics and some other sciences that suffered badly at the hands of the official ideology in the past have been learned and the present leadership is not prepared to ignore recommendations of its scientific community.

There is full awareness that the productivity of Soviet R & D is substantially lower than in the United States. It is hoped that this gap could be reduced or perhaps even eliminated through more generous financing. (Paradoxically enough the Russians seem to be more convinced than even the American that money talks.)

The half-hearted economic reforms launched in 1965 have made a very modest impact on the performance of the national economy. Any meaningful, far reaching reforms look like they will be ruled out because of the fear that they will be accompanied or followd by serious repercussions on the political plane, and thus weaken the firm grip of the Communist party on the economy and society as a whole. At the same time the policy of catching-up and overtaking the United States both economically and technologically continues to be emphasized with more and more stress on R & D sector. Hence the attitude that tends to view R & D as a near-panacea for all economic problems.

In spite of substantial economic, scientific and technological advances in the last 50 years or so, an inferiority complex still lingers on in the Soviet Union. This complex not infrequently surfaces through the barrage of boasting in numerous speeches of Khrushchev and articles in the press since then, dealing with the comparative performance of the two economic systems. The existing relative backwardness of the USSR combined with the still burning desire to prove that the Russians can be as good as the Americans, or perhaps even better, exerts a powerful influence on Soviet decision makers.

C. Conservatism and Ideological Interference

The great importance attached to science and technology and acknowledgement of their leading role in national economic development, however, did not make them immune from outright conservatism and ideological interference.

The first post-World War II decade was the period of laying foundations of modern military and space technology. It was also the time of continued emphasis on coal and neglect of oil in the national fuel balance; at the time when other industrial countries were cutting back in coal production and replacing steam engines with diesel and electric engines on their railways, the Soviet Union boasted in taking the leading position as producer of coal and steam enignes; chemical and allied industries were in the backwater of technological progress.

As for the ideological interference - its best known casualties were genetics and cybernetics. The case of Lysenko is well known in the West. By virtue of undivided party backing that gave his ideas an unchallengeable position in biology, Lysenko wiped out the great gains of Soviet genetics made under the influence of N. I. Vavilov, distorted the theory of the evolutionary growth of the organic world, and disrupted the normal growth of several branches of biology, while Vavilov and his followers suffered a fate, that was not unlike that of Galileo several centuries before. The rehabilitation of genetics was gradual and culminated in the sacking of Lysenko in 1964.[1]

In 1955 the Concise Soviet Encyclopaedia still gave the following description of cybernetics:

> Cybernetics is a reactionary pseudo-science that sprung up in the USA after World War II and then spread through other capitalist countries. In its essence cybernetics is directed against material dialectics and modern scientific physiology founded by Pavlov and Marxist scientific understanding of the laws of social development.[2]

The assault on cybernetics was shorter and less vicious than on genetics because, unlike genetics, there were no Soviet scientists of international repute in the field and cybernetics happened to relate to the priority sectors of Soviet R & D program. However, the witchhunt adversely affected development and practical application of cybernetics for years to come. In a book written in 1967 F. Binshtok complained about the continuing underestimation of cybernetics in the USSR.[1] According to a report in The Financial Times, (London), if the present crash program of computerization goes as planned, then by the end of 1975 the Soviet Union will reach the Western level of 1964.[2]

---

[1] This subject is fully treated by David Joravskyi, The Lysenko Affair (Cambridge, Massachussets: Harvard University Press, 1970).

[2] "Kibernetika," Malaia Sovetskaia Entsiklopediia, 1955, p. 219.

If we look at the other side of the coin, however, we see evidence of significant policies and concrete steps designed to increase the acquiring and exchange of modern technology.

D. Soviet Interest in Modern Foreign Technology

1. Purchases in the West

Extensive purchases have been made of Western plants and technical know-how in those areas where the Soviet Union is relatively backward; the most notable examples being the construction and commissioning in 1970 of a huge chemical combine in Mogilev, Belorussia, by a group of British firms led by the Imperial Chemical Industries (ICI), the Fiat automobile works in Togliatti, and the participation of foreign firms in the construction of a new Kama truck plant.

---

[1] F. Binshtok, Nauka upravliat' (Moskva: Izd-vo "Moskovskii rabochii," 1967), p. 130.

[2] The Financial Times, London, October 10, 1970, p. 8. See also Bohdan O. Szuprowicz, "East Europe : The Search for Computers," East Europe, 21 (April 1972), pp. 2-6; Kathryn M. Bartol, "Soviet Computer Centres : Network or Tangle?" Soviet Studies, 23 (April 1972), pp. 608-618; and D. Zhimerin and V. Miasnikov, "Industriia upravleniia," Izvestiia, October 2, 1971, p. 2.

A strong Soviet desire to have a better access to American and West European technology has contributed a lot to the recent improvement of relations between the Soviet Union and the United States and Western Europe.[1]

2. Co-operation within Comecon

At the same time further steps are taken in the greater co-operation between the Soviet Union and other countries of Comecon within the framework of growing integration between the economies of these countries in order to allow greater specialization in R & D. Within twenty years (up to 1970) the Soviet Union handed over 41,000 sets of technical documentation and samples of products to the Comecon countries and received from them 21,000.[2] 57 Soviet industrial ministries and administrations have direct links with 96 Comecon ministries and administrations,[3] and at the beginning of 1971 some 700 Soviet R & D organizations worked on common projects with 860 R & D establishments in Eastern Europe.[1]

---

[1] Herbert E. Meyer, "Why the Russians are Shopping in the U.S.," Fortune, LXXXVII (No. 2, 1973), pp. 66-71; and Keith Pavitt, "Technology, International Competition and Economic Growth : Some Lessons and Prospectives," World Politics, XXV (January, 1973), pp. 183-205.

[2] G. Malova, "Nauchno-tekhnicheskoe sotrudnichestvo SSSR so stranami SEV," _Voprosy ekonomiki_ (No. 9, 1972), pp. 119-124.

[3] Ibid.

E. Switch from Priority System to a More Balanced Technological Development

The Soviet crash program of industrialisation since 1928 has produced an industry with a strongly lop-sided development. Some technically very advanced industries such as space, aircraft, steel, electric power and some others related to military sectors stand in sharp contrast to other sectors that were by-passed in priority treatment (consumer goods' industries are a particular example). This policy has rewarded the Soviet Union with the military security which was a prime target of the first socialist state from the very beginning. However, there is growing realisation that because of interconnections between various branches, even priority sectors of R & D and industry are bound to suffer from the backwardness of the non-priority sectors.[2]

The Soviet Union has achieved a broad military power balance with the United States and yet there are indications that it is still behind its main rival even in a number of priority areas. The defeat in the moon race, in spite of a substantial lead at the beginning, is one of them. Reports from the air wars in the Middle East and Indo-China consistently indicated that the quality of Soviet-built military aircraft was inferior to the American-built machines, that the outcome of dog-fights could not be explained merely by the difference in the quality of pilots. The performance of Soviet anti-aircraft missiles was unimpressive too. Only through high concentration of missiles and guns North Vietnamese and Egyptian anti-aircraft defences could inflict significant casualties on the US and Israeli Air Forces. At sea Soviet nuclear submarines are "not as good as American, which are quieter and less susceptible to detection," according to US Defence Secretary M. Laird.[1] Finally, it is estimated that the Soviet Union is still five years technologically behind the United States in MIRV.[2] That is why the Soviet government is so strongly opposed to the attempts of some American congressmen to base US - Soviet agreements on disarmament on numerical equality.[3]

---

[1] *Ibid*. For recent further development of R & D co-operation within Comecon see G. M. Sorokin and P. M. Alampiev, *Problemy ekonomicheskoi integratsii stran-chlenov SEV* (Moskva: Izd-vo "Ekonomika," 1970) and L. Kazakevich and V. Shishakov, "Ekonomicheskoe sotrudnichestvo SSSR s sotsialisticheskimi stranami," *Planovoe khoziaistvo* (No. 10, 1972), pp. 91-102.

[2] A. A. Ignatiev, "Nauka kak ob'ekt upravleniia," *Voprosy Filosofii* (No. 11, 1971), pp. 17-26.

A part of the blame for this state of affairs in the top priority areas is attributed to the existence of technically advanced and backward sectors side by side, and there are growing demands in the

---

[1] "Interview with Defence Secretary M. Laird," U.S. News and World Report, March 27, 1972, p. 44.

[2] Ibid.

[3] Tad Szulc, "Nixon Signs Bill on Arms Accord," New York Times, October 14, 1972, p. 10.

USSR for a more balanced development of the economy. As N. Garetovskii put it, "The best results from new technology are achieved through, among other things, a balanced development of the whole national economy."[1]

F. Conclusion

A concious attempt to control the development of science and technology and to bring about rapid technical progress was built into Soviet planning at the very beginning. Because of growing difficulties in maintaining a rapid rate of economic growth, R & D is regarded as a near-panacea for the solution of economic problems. However, the rate of R & D expenditure and the growth in the number of R & D personnel have been so rapid that the prospect of the whole population engaged in R & D in a foreseeable future has become theoretically quite plausible. Hence the steady slow down in R & D expansion, although this deceleration is not as drastic as in the United States.

The high priority given in the USSR to the development of science and technology, however, did not make them immune to conservatism and ideological interference. On the other hand the Soviet Union displays a keen interest in utilizing the latest results of world technological advance for its economic growth. There is a growing realisation in the country that the old priority system of development must be scrapped because uneven development of the economy adversely affects even priority sectors.

---

[1] N. Garetovskii, "Finansy i nauchno-tekhnicheskii progress," Finansy SSSR (No. 2, 1971), pp. 27-40.

CHAPTER III

MEASUREMENT OF RETURN ON R & D

A. Introduction

The concept of technological progress of an economy is defined as a sum of all technological innovations introduced and/or further diffused in the economy over a period of time, which either permit production of products or services with a lower cost than before or permit production of products or services impossible or impractical to produce before.[1]

The results derived from spending on R & D must outweigh the costs. This is an iron law of R & D activity. It is relatively easy to calculate expenditure on science and new technology in all stages, beginning with basic research and ending with the creation of an experimental model that is fully suitable for use in industry. The main difficulties arise in determining the significance of these expenditures for technological advancement. Many individual studies have been made in recent years in an attempt to quantify the economic benefits of R & D. The underlying assumptions of these studies as well as individual numbers they produce, differ; but the overall results tend to be quite similar. The contribution of R & D to economic growth and labor productivity appears to be positive, significant, and high.[1]

---

[1] U.S. Congress, Joint Economic Committee, New Directions in the Soviet Economy, IIA, 89th Cong. 2nd sess., 1966, p. 141.

B. Problems of Measuring Return on R & D

Both Soviet and Western specialists have tried to determine more precisely the return on R & D investment. Soviet special literature offers a number of figures indicating the influence of R & D on the development of the national economy. Unfortunately those figures differ widely and therefore have to be treated with great caution.

1. Inconsistency of Soviet Data

For instance, one ruble invested in R & D produces a profit of 48 - 65 kopeks per year in one study,[1] 1.45 rubles in the other,[2] 2.15 rubles in the third case,[3] and 3 - 5 rubles in the fourth.[4] Such a discrepancy in assessing return on investment in R & D is good evidence of inadequacy and unreliability of the existing methods of calculation.

---

[1] S. I. Golosovskii, Effektivnost' nauki (Moskva: Izd-vo "Ekonomika," 1969), pp. 129-130.

[2] V. Trapeznikov, "Effektivnost" nauki," Pravda, January 18, 1967, p. 3.

[3] I. G. Kurakov,"Nauka i effektivnost' obshchestvennogo proizvodstva," Voprosy filosofii (No. 10, 1966), pp. 13-14.

[4] V. Sominskii, "Ekonomika nauchnykh issledovanii," Ekonomicheskaja gazeta (No. 10, 1967), p. 7.

2. Difference in Soviet Assessments of the Return in the USA

American publications indicate that their attempts to calculate return on R & D investment have been also not a success. Nevertheless, one of the leading Soviet specialists on the problems of science Dr. G. M. Dobrov, takes Trapeznikov's result of 1.45 rubles as the most probable and compares it with two dollars profit per one dollar of R & D investment claimed by one of American scientific magazines,[1] thus indicating a substantial gap between American and Soviet R & D productivity. Professor V. Sominskii puts the profit of American R & D efforts, with reference to some unspecified American sources, at between 100 and 200 %.[2] Soviet sources also indicate that return on R & D expenditure in the Soviet Union is approximately four times as high as the return on other capital goods. The same sources indicate that this return in the United States is eight times.[3]

C. Methods of Measuring Return on R & D

There are also other indicators of relative productivity level of Soviet R & D program.

---

[1] Dobrov, p. 96.

[2] Sominskii.

[3] Dobrov.

1. Nobel Prizes

To start with, in the post-war period of 1946 - 1972, 63 Americans received Nobel Prizes for their achievements in science (physics, chemistry and medicine),[1] against 7 Soviets, despite a higher share of resources allocated in the USSR for fundamental research.[2]

2. Patents and Scientific Papers Presented

There are more scientists in the Soviet Union than in the United States and yet they register three times fewer patents than their American colleagues,[3] and only 3 % of them can be sold abroad.[4] A quarter of all scientists live and work in the USSR, but they registered only one sixteenth of all patents registered in the world in 1969 (400,000 in the world, 26,000 in the USSR).[5] Academician Kapitsa, comparing the quantity of scientific papers produced in the Soviet Union and the United States, came to a similar conclusion that the "productivity of our scientists is lower than that of scientists in the United States."[6] In this particular case any comparison is more difficult in view of the vastly different value of each paper and the amount of repetitive materials in them in both countries.

---

[1] A significant proportion of them were immigrants from Europe.

[2] Lebedev, p. 250.

[3] *Ibid.*, p. 253.

[4] *Ibid.*

[5] M. Kotanian, "Patenty, litsenzii i nauchno-tekhnicheskii progress," *Planovoe khoziaistvo* (No. 8, 1971), pp. 72-77.

[6] A. Kapitsa, "Proizvoditelnost truda uchenykh," *Komsomol'skaia pravda* (January 20, 1966), p. 3.

3. Number of Scientists and Expenditure on R & D

It is often assumed that R & D output can be measured by counting the number of scientists and the expenditure on R & D. This measure is based on an inference which is not entirely valid in the Soviet case. If it were an accurate measure then clearly the number of Soviet patents shoudl exceed the number of US patents, which is not the case.

4. M. Boretsky's Estimates

In his paper published by the Joint Economic Committee of the US Congress, M. Boretsky stated that the overall level of Soviet technology of 1962 has lagged behind the United States by some 25 years. In terms of some specific indicators this lag seems to have been as much as 40 years or more and in terms of a few only 5 to 7 years.[1]

D. Growth in Labor Productivity as a Yardstick of R & D Influence on Technological Progress

In the view of many scientists, to use data for growth in labor productivity as a yardstick, as a criterion of scientific and technological progress, is a primitive approach to creative activity.

---

[1] U.S. Congress, Joint Economic Committee, New Directions in the Soviet Economy, p. 143.

In this chapter we have discussed some measures in R & R output. One could argue that R & D could not be considered separately from the total production system. Therefore, some attempt should be made to use the "primitive" method of correlating R & D activity with the growth in labor productivity.

According to data of the USSR Central Statistical Administration, the number of Soviet scientists employed in engineering, that is in the purely applied sciences, rose from 107,000 in late 1959 to 363,000 in late 1968 - a 3.4-fold increase.[1] At the same time, the hourly output per industrial worker during the same period increased only 1.7 times. Moreover, it should be considered that a substantial percentage of the increase in labor productivity should be attributed to better organization in labor and production, to improvements in equipment and technology due to the work of plant engineering services, and of many innovators. According to special research, only about 60 % of all increase in labor productivity in all branches of the national economy is the result of introducing new technology, while 20 % is attributed to improved organization of production and another 20 % to a rise in the skill of the workers.[2] At the same time, according to very conservative estimates the rate of growth in expenditure on technical sciences for 1959 -

---

[1] Rumiantsev.

[2] N. M. Oznobin, A. I. Rogov, and A. I. Klinskii, Tekhnicheskii progress i planomernoe razvitie narodnogo khoziaistva (Moskva: Izd-vo "Mysl'", 1971), p. 5.

1968 was about four times greater than the growth rate of labor productivity in industry.[1]

The gap between the growth rate of R & D potential and labor productivity has tended to increase in recent years. Of course, an increase in the number of scientists cannot produce an immediate return because there is an inevitable time lag between the elaboration of scientific and technological advances and their incorporation into practical work. However, even when this time lag is taken into account, their return on investments in R & D is regarded by Soviet specialists as unsatisfactory.

As Soviet experience shows, the time lag between the technical realization of an idea and its broad dissemination in production is five years.[2] If one compares three consecutive periods, 1953-1958, 1958-1963, 1963-1968, the results are the following:

In 1953-1958, the number of personnel in the sphere of engineering sciences in the USSR increased by approximately 75 %, while the hourly labor productivity in industry during the subsequent five year period increased by 47 %.[3] In 1958-63 the number of personnel in the engineering sciences increased by 166 % while hourly labor productivity in industry for the subsequent five-year period increased by only 28 %.[1]

---

[1] A. Kolosov and V. Lipatov, "Vnedrenie goluboi mechty," Literaturnaia gazeta (No. 25, 1971), p. 11.

[2] Lebedev, p. 251.

[3] Rumiantsev.

E. Conclusion

Although all above mentioned methods of estimation of productivity of Soviet scientists and their influence on technological advancement of Soviet industry leave much to be desired, the overall picture is nevertheless uniform. The output of Soviet R & D program is generally well below the results of the Americans in terms of quantity and quality and many Soviet scientists, economists and administrators believe that the country does not get value for its money. In oder to understand the problems behind this the system of Soviet R & D has to be examined.

---

[1] *Ibid*. It proved to be impossible to make comparisons between the growth in labor productivity and the increase in expenditure on engineering sciences because of the absence of necessary Soviet data.

CHAPTER IV

SOVIET INDUSTRIAL R & D SYSTEM

A. The Main Difference Between Soviet and Western R & D Systems

The chief structural differences between Western and Soviet industrial research and development reflect differences between a competitive market economy and a centrally-planned economy. In spite of the much increased role of government in Western R & D, it remains true that for a substantial part of private and some state industry in all Western countries, it is the force of competition which presses firms to develop improved products and to cut costs by developing new production processes; if a company does not seek to maximise its profit (to put it in very simplified terms), it at least seeks to maintain its share of the market. It is primarily in response to the challenge of the market that research and experimental production facilities are developed. Even in the case of companies working mainly for the state, the wish not to lose development contracts to one's rivals often still plays a major role.

The chief aspect of the Soviet set-up for research and development stems from the fundamental nature of the Soviet state wherein the allocation and employment of national resources are determined and enforced by the central government. As is true for all economic, cultural, and other functions of Soviet society, the lines of control over research and development progressively converge toward the Central Committee of the CPSU and the Council of Ministers of the Soviet Union. All basic decisions on the scale, direction and organization of R & D are made or are subject to approval at the uppermost level of authority.

B. The Organization of Soviet R & D

The traditional organization pattern of Soviet R & D is a network of specialised organizations which are usually separate, both geographically and administratively, from industrial enterprises.[1]

Each Soviet ministry consists of a number of departments or Chief administrations (*glavki*). The main responsibility for R & D falls to the Technical Administration which acts as a clearing house for plans for new technology prepared by Production Administrations. These plans are eventually presented to the ministry for confirmation.[2]

C. Research Organizations

Applied research is carried out in a wide variety of organizations, but is mainly concentrated in "branch" research institutes The titles of these research institutes (*Nauchno-issledovatel'skie institute - NII*) are very confusing and are used quite carelessly by the Russians themselves. Major research institutes are usually called

---

[1] This system was abolished in 1957 and re-established in 1965.

[2] *Pravovye voprosy nauchno-tekhnicheskogo progressa v SSSR* (Moskva: Izd-vo "Iuridicheskaia literatura," 1967), p. 40.

All-Union (Vsesoiuznyi-VNII), Central (Tsentral'nyi-TsNII), or State (Gosudarstvennyi-GNII), research institutes. These often have branches (filialy) or divisions (otdeleniia) in other parts of the country.

However, applied research is not the exclusive prerogative of the "branch" research institute. Research institutes of the various Academies of Science and Vuzy also make a significant contribution, although in the case of the Academy system this has diminished in recent years since the removal from its control of some technology-oriented research institutes.[1]

D. Design Organizations

The chief type of organization responsible for designing new products in the country is the design bureau (konstruktorskoe biuro). As in the case of research institutes, there is a considerable variation in title. The design stage of a new product is formally completed by the preparation of the working drawings for the manufacture of the prototype. The most important bureaux also have their own experimental and testing facilities and are responsible for the manufacture and testing of prototypes as well as for design. In other cases the prototype is made and tested at a production enterprise.

---

[1] Linda Lubrano Greenberg, "Soviet Science Policy and Scientific Establishment," Survey (No. 4, 1971), pp. 51-63.

E. Ministerial Emphasis on Production and the Consequent Lack of Experimental Facilities.

The obstacles to smooth technical innovation created by structural separation between research and production are, in the case of non-priority industries, reinforced by some aspects of the mechanism of economic planning. Soviet planning has traditionally been oriented towards the achievement of maximum production, and the success of both the ministry and its constitutent factories has depended primarily on the fulfillment of the production plan. The incorporation of product and process innovation in a central plan of the Soviet-type is very difficult and becomes more difficult as the economy becomes more complex. It could be said that the mechanism of Soviet central planning of the traditional type operates most successfully in advancing innovation on a narrow priority front, but is too insensitive to cope with the general advance which the Soviet government now desires.

The main factor leading to a squeeze on development facilities is the high priority which the economic planners still assign to production relative to innovation. Despite numerous official declarations concerning the necessity to boost the introduction of new technology, Soviet sources continue to point at the testing and experimental facilities as one of the major bottlenecks on the way from science to production.[1] Ministries continue to pay scant attention to the provision of development facilities: 25 industrial ministries directed for the last 3 years only 0.4 % of their total centralised investment for this purpose.[1] Nevertheless, even these totally inadequate testing and experimental facilities are often distracted by having to produce products which have already been assimilated, while R & D organizations are unable to test new products. It has been estimated that as much as 50 % of the capacity of experimental production bases of all-union and republican significance is taken up with mass production.[2] In some cases ministries even discourage their enterpises from stopping production of old models and switching to the manufacture of more up-to-date ones,[3] for the fear that the start of production of new models could adversely affect the overall production plan of the ministry.

---

[1] V. Shentov, "Nauchno-tekhnicheskii progress i khoziaistvennaia reforma," Voprosy ekonomiki (No. 3, 1971), pp. 143-146.

F. Slow Introduction of New Technology into Production

There is a growing concern in the Soviet Union over the slowdown in the utilization of inventions in recent years.[4] The proportion of registered inventions being introduced into production falls year by year: 52.6 % of all registered inventions were introduced into the economy in 1965.[1] In 1966 this proportion dropped to 30.7 %, in 1968 to 29.5 %.[2] Of all the inventions registered in 1968 only 23.5 % were introduced that same year.[3] Many of the inventions have to wait their "turn" for years.[4] It is common knowledge that the more rapidly an innovation is applied in practice, the greater are its economic benefits. On the other hand, if an invention is not introduced for a long time, it loses its value and ultimately may become obsolete technically. Y. Maksarev, Chairman of the Committee on Inventions and Discoveries, severely critizes ministries for the sluggishness in the application of inventions. The ministries recieve complete information about the inventions relevant to their sphere of competence that have been reported and registered. Nevertheless, it is not often that ministries themselves initiate the introduction of inventions.[5] As a rule, both the Committee and inventors remind them more than once that it would be useful to start applying innovations.[6] Year after year, says Academician Trapeznikov, some ministries fulfill their plans for the introduction of new equipment only by 70 - 80 %, sometimes by as little as 60 %.[1] This however, does not prevent ministries from regularly fulfilling and even overfulfilling of their production and profit plans, and giving good bonuses to their personnel.[2] Academcian J. M. Kolotyrkin, referring to the necessity to speed up the introduction of the successful results of R & D programs into production, says:

---

[1] O. Gribanova, "Ekonomicheskie problemy razvitiia nauki," Voprosy ekonomiki, (No. 10, 1971), pp. 146-152.

[2] R. V. Burks, "Technology and Political Change in Eastern Europe," Change in Communist Systems, ed. Chalmers Johnson (Stanford: Stanford University Press, 1970), p. 275.

[3] N. Mironov, "Staraia model'," Pravda (July 14, 1971), p. 3.

[4] A. Osekin, "O sovershenstvovanii sistemy material'nogo pooshchreniia za razrabotku, sozdanie i osvoenie novoi tekhniki," Finansy SSSR (No. 8, 1971), pp. 30-35.

---

[1] Kotanian.

[2] Ibid.

[3] Y. Maksarev, "Vazhnoe zveno tekhnicheskogo progressa," Pravda (June 30, 1969), p. 3.

[4] Ibid.

[5] Ibid.

[6] Ibid.

> If we do not this, or do it with a long time lag, then science instead of a powerful factor of progress could turn into a burden for the national economy.[3]

G. Conclusion

The main weakness of Soviet R & D lies in its administrative and geographical separation from production enterpirses. The high priority given to the fulfillment of the production plan relative to innovation makes it unrewarding for the ministries to spend much money and effort on the introduction of new technology. As a result of this many inventions are not being introduced into production for years, thus greatly reducing the return on the investment in R & D.

---

[1] Ibid.

[2] Garetovskii.

[3] L. Gliazer, "Ekonomicheskaia effektivnost' nauchnogo issledovaniia," Planovoe khoziaistvo (No. 9, 1971), pp. 45-53.

CHAPTER V

R & D IN RESEARCH AND DESIGN ORGANIZATIONS

A. Separation of R & D Organizations from Plants

The main obstacle to a more active participation of Soviet research and design organizations in promoting technological progress in industry lies in their administrative separation from the production enterprises.

The objective of research and design organizations is to discover new knowledge based on research and to prepare models and drawings of new products and processes; and, if experimental production facilities are available, to create experimental and even industrial prototypes.

In principle, research institutes and design bureaux are responsible for the completion of research and development itself rather than its application in the plant. Research institutes without design bureaux of their own complete their work on a research theme by preparing a paper; design bureaux without production facilities complete their work with their drawings and models. Until recently, research and design organizations were neither penalised, nor rewarded, as a result of the success or failure of their prototype in production.[1] However, it is unfair to put all the blame on scientists and designers for this situation. Design bureaux working on a new machine, for example, often do not know at which enterprises it will be used. Without knowing the peculiarities of the plant in question, it is difficult to gear the project to the production conditions of the plant. In those cases when researchers and designers know about "their" plant from the beginning of the project, the results are rewarding. The experience of the Design Bureau of Oil Instruments shows that when the manufacturer was determined at the beginning of designing, the time for designing was reduced by 2.5 to 3 times and expenditure by 1.3 to 1.5 times.[1]

---

[1] Rumiantsev.

B. Collaboration Between R & D Organizations and Plants

At present a typical pattern of project development consists of a number of stages on the way from research to production, where after the completion of one stage commences the following one. The total time period required for a creation of a new model is a sum of the periods of each stage. Such a set-up is conducive to a large number of mistakes in technical documentation, leading to numerous changes during the actual introduction of the product for mass production.[2] Soviet sources stress that a lot of time and money could be saved through a "parallel" development, when research institute, design bureau and production enterprise work on the project as one team from the very beginning. V. Tuchkevich, Director of the Ioffe Physico-Technological Institute, writes that, working from the beginning with a branch research institute of the Ministry of Electrical Engineering and Elektrovypriamitel' plant, they succeeded in developing and producing a powerful automatic transistor rectifier within 3 years - much faster than expected.[1] In another case, Paton Electro-Welding Institute and the All-Union Research Institute of Electro-Welding, working together, developed a series of automatic and semi-automatic welding machines in two years instead of the planned nine.[2]

---

[1] K. Kirnarskaia, "Rezervy sokrashcheniia srokov i zatrat na osvoenie novoi tekhniki," Planovoe khoziaistvo (No. 11, 1971), pp. 84-87.

[2] Ibid.

However, the "parallel" system can work only when there is a desire to work together, and this is often absent. Even when various R & D organizations are pressed into a common project they continue to work on their own, with no general manager responsible for the project as a whole.[3] Instead of the principle "One order - one contract - one responsible agent," the pattern in fact has become one in which each developer solves his own part of the problem, as best as he can, and it is the plant who answers for the results as a whole. For example, the automatic control system for the hot-rolling strip mill at the Novolipetsk Steel Plant was being developed by sixteen organizations over a period of several years. Nevertheless, the mill was started without the automatic system, because part of the system was still being designed. No design for the system as a whole has ever been developed. As a result, some of the devices were installed, tested and then disconnected, since they simply proved to be unnecessary. Control system of the mill was to have been linked to a computer, but no one thought to standardize the signals linking it with other devices. Therefore the computer was unable to work.[1]

---

[1] V. Tuchkevich, "Ot idei do konveiera," Izvestiia (January 7, 1972), p. 2.

[2] V. Smirnov, "Soiuz laboratorii i tsekha," Izvestiia (March 23, 1972), p. 2.

[3] A. Levin, "Kak rozhdaetsia sistema," Pravda (July 30, 1971), p. 3.

Some R & D organizations are being criticized for trying to preserve their "independence", which in fact means a desire to continue a peaceful, uneventful life having little contact with industry.[2] The Soviet press frankly admits that there are still scientists in the country who avoid production and are ill-disposed toward active involvement with it.[3] This desire to be left alone is strengthened by the insufficient reward (20,000 rubles maximum) offered even in case of large scale projects involving many R & D organizations.[4]

---

[1] Ibid.

[2] Editorial, Pravda (May 10, 1969), p. 1.

[3] Ibid.

[4] Kotanian.

C. Barriers Within Economic Administration

No matter how difficult it is to introduce new products into mass production within one ministry or department, that problem is dwarfed when a project requires collaboration of several ministries or departments.

Large scale inter-branch problems which, in the long run, were the most important for industry as a whole were neglected because it was difficult to secure agreements between ministries; they tended to direct their R & D programs to solve the short-term problems of immediate value to themselves. Lack of communication between ministries did not facilitate "spin-off" into other areas and this restricted the number of opportunities for introducing technical innovation into production.

To combat this, decentralization of the economic administration was carried out in 1957. Under this system where research and design organizations and plants were both under the same *sovnarkhoz*, they were more closely in touch. However, narrow ministerial affiliations were replaced by regional affiliations. The large scale projects involving R & D organizations and industrial enterprises of several *sovnarkhozy* became very difficult. The implementation of the nation-wide scientific and technological policy was being broken time and again and this prevented creation and utilization of new technology on the country-wide scale.[1] The disadvantages of the new set-up were out-weighing its advantages and in 1965 the ministerial system was restored.

---

[1] I, Artobolevskii, *Puti razvitiia tekhniki v SSSR* (Moskva: Izd-vo "Nauka", 1967), p. 49.

D. Shortage of Testing and Experimental Facilities

A still insufficient experimental and testing base of many R & D organizations is another reason for the difficulties and long periods of putting new products on the conveyor. Research institute and design bureaux with good experimental bases create, as a rule, more developed designs with less time and expenditure, since they have opportunity to test new designs properly, and introduce necessary changes in time. Experience shows that the availability of well equipped experimental facilities allows institutes and bureaux to reduce the time needed for development of designs by 1.5 to 2 times and expenditure by 50 to 60 %.[1]

It is true that in recent years investment on the creation and development of testing and experimental facilities and scientific instruments rose substantially. From 1959 to 1966 the expenditure on this item for Soviet research institutes increased 3.3 times.[2]

Nevertheless, recent Soviet accounts have suggested that Soviet researchers and designers are still much more poorly equipped than their colleagues in the United States, France, Britain and West Germany.[3]

---

[1] Kirnarskaia.

[2] G. M. Dobrov, Naukovedenie, prognozirovanie, informatika (Kiev: Izd-vo "Naukova dumka", 1970), p. 97.

[3] G. M. Dobrov, Upravlinnia naukoiu (Kyiv: Izd-vo "Naukova dumka," 1971), p. 119.

E. Financing R & D

R & D activity is a very awkward item for planning and allocation of finance because of its fairly high uncertainty factor.[1] Research undertaken on the cost of research work proved that the discrepancy between the estimated and actual spending was ± 30 - 50 %.[2] If one compares this figure with the margin of ± 5 % allowed by the finance institutions and ministries, it is easy to see the difficulties in which research groups find themselves.[3] Therefore in order to reinsure themselves against harsh sanctions for overspending and not observing schedules, R & D organizations often exaggerate their requirements in money and time and this is perhaps the main explanation for the rather paradoxical situation: while US firms frequently report heavy overspending, the reported spending on R & D programs in the USSR in recent years amounted only to 97 - 98 % of the planned allocations,[4] thus leaving substantial resources unused. It has become normal to write off money, not on the basis of the actual spending on particular projects, but from a desire to be within the allocated budget, redistributing expenses between the projects. Therefore, reporting has ceased to reflect the actual spending for each project and to a large extent has lost its value.[1]

---

[1] I. E. Okpostsvaridze, Gosudarstvennyi biudzhet gruzinskoi SSR na sluzhbe nauki (Tbilisi: Izd-vo "Metzniereba," 1970), p. 51.

[2] L. M. Gatovskii, Problemy ekonomicheskogo stimulirovaniia nauchno-tekhnicheskogo progressa (Moskva: Izd-vo "Nauka", 1967), p. 155.

[3] Ibid.

[4] L. Veger, "Ekonomicheskaia effektivnost' v usloviiakh neopredelennosti," Voprosy ekonomiki (No. 2, 1972), pp. 47-58.

The probability of achieving expected results increases with each stage of development. However, the existing "Basic Methodology for Assessment of Ecnomic Efficiency of R & D Projects" does not take into account this factor and the expected return from the projects in different stages of development receive equal evaluation.[2] As a result of this, projects in their initial stages were constantly overestimated. The systematic overestimation of projects in their initial stages was one of the reasons for insufficient interest paid by R & D organizations to the later stages of development, to the introduction of the results of R & D activity into production.[3]

F. Adverse Effect of Rigid Planning on Creativity in R & D

R & D organizations are not given any leeway for their mistakes and miscalculations. This is expressed in assessment of their work in form of the fulfillment of the planned expenditure schedules and technical parameters of new products.[4] Since this approach is contrary to the very nature of scientific inquiry, research institutes and design bureaux are forced to violate either the laws of scientific inquiry or the existing order of planning. Among those violations are the desire of R & D organizations to concentrate their plans at modernization and improving existing processes and products and shying away from the problems where the risk factor is much greater. The assignments for genuinely new projects with their much higher risks and possibilities of not meeting the financial and schedule plans, and even failure, are included in R & D organizations' plans reluctantly.[1]

---

[1] Ibid.

[2] Ibid.

[3] Ibid.

[4] Ibid.

Even those models that are listed as "new" in fact represent the yesterday of technology.[2] In creation of new types of Soviet machines and equipment, only in 10 % of all projects inventions are used.[3] In a number of cases "new" technology is new only to a given ministry, although it is well below world standard.[4]

G. Mismanagement

Among the reasons that adversely affect the productivity of researchers and designers is mismanagement.[5] One of the commonest complaints is that highly trained people spend between 1/3 and 1/2 of their working time on the work that is well below their qualification.[1] Sociological research conducted by the Department of Scientific Communism of the Academy of Social Sciences found that the activity of a strictly research nature takes up only 61.5 % of the researchers' working time.[2] Professor V. Tereshchenko, who for many years worked with research organizations in the United States and later came to the Soviet Union, compares the use of time, by Soviet highly qualified personnel, very unfavorably with the use of time by their American colleagues.[3] If one were to cut by a half the researchers' load of low-qualified work, this would be equal to an increase of 100,000 research workers.[4] The reorganization of staff structure in many Soviet research organizations takes place in a one-sided mannder: cutting back on the number of support personnel, which aggravates even more the inefficient use of researchers. One Soviet scientist made the following comment on this point: One more staff reduction in our institute and the doorman at the entrance will be replaced by a candidate of science.[5]

---

[1] *Ibid.*

[2] Lebedev, p. 269.

[3] *Ibid.*, p. 270.

[4] E. Artem'ev and L. Kravets, "O merakh po uskoreniiu tekhnicheskogo osvoeniia nauchnykh dostizhenii," *Planovoe khoziaistvo* (No. 7, 1972), pp. 109-117.

[5] V. Mozhnin, "Skol'ko stoit eksperiment," *Izvestiia* (March 26, 1972), p. 3.

---

[1] Volkov, p. 219.

[2] Dobrov, Potentsial nauki, p. 117.

[3] Volkov, p. 219.

[4] *Ibid.*, p. 220.

[5] B. Poshataev and Y. Poshekhonov, "Rabochii den' uchenogo," Pravda (February 6, 1969), p. 2.

H. Payment of R & D Personnel

At present the overall bonus fund for workers of research and design organizations cannot exceed 4 - 8 % of the annual wage fund, and the bonus for each staff member cannot exceed 50 % of his basic wage, regardless of the fact that the productivity of some researchers and designers often exceeds the productivity of others many times over.[1] This results in a situation where a gifted inventor at times gives the economy more than an entire group of designers does, but he can be given an additional payment only 50 % larger than the one that is given to the man with the least initiative.

The prevailing Soviet pay system does not always promote an increase in the effectiveness of researchers and designers. Its effect is felt in a single direction encouraging the preparation of dissertations. Under this system, the only possiblity of increasing one's earnings lies in obtaining the academic degree of candidate or, better still, that of doctor. Since it is easier to follow the beaten track than to break new ground, many people avoid taking up as research topics problems that are innovatory and really important to theory and practice.[2] After obtaining his degree and appropriate position and earnings, the young researcher has no stimulus for heightening his labor productivity in the future.[3]

---

[1] G. Popov, "Reforma u dverei instituta," Pravda (August 15, 1968), p. 2.

[2] Y. Kolotyrkin, "Novoe v oplate truda uchenykh," Pravda (March 25, 1969), p. 3.

[3] Ibid.

In December 1968 the Karpov Physical Chemistry Research Institute changed to a new system of pay for its researchers. According to the Institute's new pay system a guaranteed salary, 25 to 30 % lower than the standard figure, has been established for each category of research staff. If a person works very well he can receive 25 to 30 % more than the standrad figure. For instance, a candidate usually received 300 rubles per month. Now a guaranteed salary of only 225 rubles has been established for him. But for maximally effective work he can receive 375 rubles. The same holds true for all categories of researchers.[1] The results of this experiment have been praised,[2] but there are no reports of other R & D organizations following suit.

I. Economic Calculations

Improved central planning and organizational reforms in the R & D system, though important, are nevertheless now regarded in the Soviet Union as being quite insufficient to handle the problem of technical innovation.

The key to technological progress is seen by most economists and by many official statements to lie in reliance on economic calculation as the main guide to decisions concerning R & D.

---

[1] L. Gatovskii, "O kompleksnom upravlenii naukoi, tekhnikoi, proizvodstvom," Kommunist (No. 10, 1971), pp. 27-39.

[2] "Uskorenie nauchno-tekhnicheskogo progressa - delo vsego naroda," Kommunist (No. 18, 1971), pp. 3-13.

One of the problems of Soviet R & D is to be found in a very weak economic training of Soviet ecientists and engineers.[1]

> Our graduates are not always able to give a clear analysis of the economics of a design for a new product or technology. They have trouble answering questions as to how long a machine they have designed will remain up to date and when obsolescence will set in; they are not always able to evaluate its reliability and its suitability for repair, or to determine the labor savings that will result from introduction of the new machines. This inability entails unnecessary expenditure even in the development of very original ideas.[2]

For many years, the desired technical parameters were the sole consideration in machine design. This orientation was even emphasized in the title of the document "Technical Assignment" (*tekhnicheskoe zadanie*). As a result, the developers of new equipment inevitably came to think of the economic side of new machine as something unimportant.

This weakness of economic training is responsible to a large degree for the current trend where the price for new machines greatly outpaces the improvement in their performance. For instance, the price of a new excavator EKG-8 is four times higher than that of the old model EKG-4, although its productivity is only 50 - 80 % greater;[3] the ABSh self-propelled drilling rig is ten times more costly than the extensively used NKR-1000 rig, while the productivity of the former is only twice as high.[1] The developers of new equipment came to think of the economic characteristics of machines as something of secondary importance. All kinds of organizational measures have been taken to combat this attitude; the introduction of mandatory calculations of the economic effect, the setting up of special groups at R & D organizations to calculate this effect, etc.[2] As a rule, however, such calculations are made after the new equipment has been created, i.e. after the expenditures have already been made. Therefore, these calculations are often aimed at the justification of already created models.[3] Moreover, the realistic nature of these calculations is very questionable. For instance, the technical parameters of the new machines and equipment are not those that are actually possible in operation, but hose that are maximally obtainable in theoretical terms, although this normally is impossible under actual working conditions.[4]

---

[1] G. Flegontov, "Rabotaet sektor effektivnosti," *Ekonomicheskaia gazeta* (No. 35, 1972), p. 7.

[2] Y. Abramov and A. Proskuriakova, "Kak uchit' ekonomike," *Pravda* (July 18, 1971), p. 3.

[3] Lebedev, p. 147.

---

[1] Rumiantsev.

[2] Ibid.

[3] Ibid.

[4] Ibid.

Despite the current drive for paying more attention to economic consideration in R & D activity, some ministries continue to treat economic groups as something unimportant. When periodic campaigns to trim the number of personnel are launched, the economists are among the first to go.

In the ministry of Heavy, Power and Transport Machine-Building the number of economic laboratories and bureaux fell during the last three years by 40 % (72 on January 1, 1969 and 45 on January 1, 1972), while the number of personnel in them was almost halved,[1] and this is despite the official declarations that pledged to strengthen economic services.[2]

J. Conclusion

The separation between branch R & D organizations and production enterprises is undoubtedly one of the greatest obstacles to technological progress in the country. This situation, plus rigid planning of R & D and lack of experimental, testing, and production facilities at the disposal of R & D organizations adversely affect the productivity of scientists and engineers. Mismanagement and an inadequate pay structure for creative activity are further explanations of the rather low productivity of Soviet R & D organizations. Attempts to remedy this situation with proper economic calculations produced disappointing results; the reason is that for many years Soviet scientists and engineers regarded the economic aspects of their work as something unimportant - and old habits die hard.

---

[1] D. Mishtin, "Ischezla ne odna laboratoriia," Ekonomicheskaia gazeta (No. 37, 1972), p. 5.

[2] Ibid.

CHAPTER VI

PLANT R & D

A. Shortage of Development Facilities

The leading role played by branch research institutes and design bureaux in Soviet R & D program and, conversely, the weakness of plant R & D is one of the main feautres of the system.

One of the most frequent complaints in the Soviet press concerning industrial R & D is that plants lack laboratories, design facilities and experimental shops for proving prototypes of new peoducts and processes. Any significant research work is only being carried out at big enterprises, because R & D facilities at medium and small plants are sparse, their main function being quality control and minor modifications to work received from outside R & D organizations. Some authors complain that plant R & D is regarded simply as an auxiliary service and is treated accordingly.[1]

According to one account, the Angarsk Petrochemical Plant increased its output 7-fold in twelve years, but its R & D facilities remained the same.[2] Even the construction plans for new machine-building plants do not provide the stablishment of strong research centers.[1] Furthermore, even the existing experimental bases are often, under pressure from the production plan, to switch to mass production.[2] Soviet sources give examples where some 80 to 90 % of all production of many experimental plants consists of mass production, though some other enterprises, while retaining their name "experimental," have entirely switched to mass production.[3]

---

[1] D. Orechkin, "Zavodskoi forpost nauki," Izvestiia, (October 21, 1972), p. 1.

[2] Ibid.

B. Pay to R & D Personnel

Any organizational structure in order to be effective has to be supported by appropriate financial arrangements. Therefore, the relatively low position of plant R & D is emphasized by the existing pay structure. The salary of the head of a plant laboratory, for example, could not rise to more than 50 % of that of the head of an equivalent laboratory in a research institute,[4] and designer in design bureaux earn more than plant designers.[1] This arrangement was widely criticized, but the probability that the situation will be drastically changed in the foreseeable future has been discounted because to do so could seriously weaken the leading role of outside R & D organizations in technological progress in the country.[2] As a result, qualified personnel tend to drift from their plants into outside research institutes and design bureaux, attracted by better pay, longer vacations, higher status and the prospect of more interesting work. The movement of personnel away from the enterprise means that inexperienced engineers have to be promoted as a stop-gap measure. In order to keep their experienced specialists in their laboratories and bureaux, enterprises have to manipulate their staff list, inventing all kinds of "leading positions," so that they could offer more decent salaries, corresponding to the qualifications and contributions of these men.[3]

---

[1] M. Lavrinovich and I. Gurus, "Dokazano na praktike," Pravda, January 15, 1972, p. 3.

[2] Editorial, Pravda, July 17, 1971, p. 1.

[3] Kotanian.

[4] I. Shashmin, "Predpriiatiiam - kadry issledovatelei," Pravda, January 9, 1966, p. 2.

Ekonomicheskaia gazeta recently summarized the dilemma of Soviet industrial R & D in the following way:

---

[1] M. Lavrinovich and I. Gurus.

[2] V. Evropin and E. Sapilov, "Kompleksno planirovat' nauchno-tekhnicheskii progress," Planovoe khoziaistvo (No. 6, 1971), pp. 3-12.

[3] R. Margolit, "Zavodskaia mimikriia," Literaturnaia gazeta (No. 25, 1971), p. 11.

> Research organizations close to production are lacking the necessary laboratory and experimental base and trained personnel, while outside research institutes have little understanding of the problems and make little impact on their solutions.[1]

C. Factor Inhibiting a Greater Participation of Plants in Technological Progress

Throughout the period of planned industrialization, the main success indicator for the Soviet enterprise had been the fulfillment, or better still, overfulfillment of its production plan. On it depended the earnings of the workers and the bonuses and promotion prospects for the management. This production-oriented system of planning necessarily greatly inhibited the willing participation of the enterprise in all stages of technical innovation.

1. Production Plan vs. New Technology

Plants try to avoid the involvement with developing industrial prototypes and new processes for research and design organizations, most of which, driven by the lack of their own erperimental production facilities, seek the cooperation of the plant.

The introduction of new products into mass production causes a lot of unhappiness at the plant. The stoppages for retoolign and the period of assimilation whcih are required inevitably disrupt the normal cycle of production and endanger the success of the basic plan. Even introduction of already well developed new product, requiring reorganization of production, tends to be resisted by the factory concerned with the fulfillment of its production plan. For instance, the All-Union Institute of Heavy Machine-Building together with the South Urals Machine-Building Plant have developed a new converter, smaller and more efficient than the old model. Nevertheless, plants continue to manufacture the old model and Gipromez, the head institute in constructing new enterprises of steel industry, in its design of a new shop at Novolipetsk Steel Plant, did not dare to include the new converter.[1] In some cases the dislike of the new leads to a paradoxical situation. The State Institute Giprostal' developed original hydraulic shears for the steel industry. The new shears are being produced by the Starokramatorsk Machine-Building Plant almost entirely for export, because Soviet steel plants showed little interest in it.[2] There are other cases when Soviet inventions and new products have good demand abroad, but none at home.[3]

---

[1] V. Churpita, "Ochevidnye minusy," Ekonomicheskaia gazeta (No. 2, 1973), p. 7.

This dislike of the new is based on solid economic grounds. In 1970 over two-thirds of enterprises under nine machine-building ministries that introduced innovations made them at a loss: their profitability either went down or some of them found themselves in the "red."[1]

---

[1] A. I. Tselikov, "Konstruktor i tempy ekonomicheskogo progressa," Ekonomicheskaia gazeta (No. 4, 1973), p. 5.

[2] Y. E. Maksarev, "Puti vnedreniia tekhnicheskogo progressa," Ekonomicheskaia gazeta (No. 26, 1970), p. 5.

[3] Ibid.

Introduction of new technology, assimilation of new technological processes require large expenditures, which disrupt normal production at the enterprise, adversely affect plan fulfillment and the size of bonuses among the employers.

5

2. Lack of Incentives for Enterprises

In order to offset this lowering in economic performance of the enterprises involved in introduction of new technology, the Fund of Assimilation of New Technology has been set up, totalling now 1 billion rubles.[2] Nevertheless the contributions from the fund cover only part of the expenses incurred in the assimilation of new products. For instance, Nizhnii Tagil Steel Plant spent 1,715,000 rubles for the assimilation of new technology in 1970, but received from the fund only 616,500 rubles;[3] 247 enterprises of Armenia spent on the whole 18 million rubles for new technology but received from the fund only 5.7 million rubles.[4]

---

[1] K. Kedrova, "Uskorenie realizatsii nauchno-tekhnicheskikh dostizhenii," Voprosy ekonomiki (No. 7, 1972), pp. 50-61.

[2] G. Kiperman and B. Koshlich, "O fonde osvoeniia novoi tekhniki," Voprosy ekonomiki (No. 6, 1972), pp. 119-122.

[3] Ibid.

[4] Kotanian.

Therefore, it is not surprising that introduction of new technology plays an insignificant role in the income of people involved in it. In most enterprises the bonus fund for new technology is less than 1 % of the wage fund.[1] In the industries producing consumer goods it is even less.[2] In the machine building industry of Dagestan, the average size of the bonus in 1968 was only 2 to 3 rubles a month and only 20 to 33 % of all employees were given any bonus for the introduction of new technology. In 1969 bonuses for creation and assimilation of new technology made up only 2.1 % of the total bonuses in Soviet industry.[3]

3. Lack of Incentives for Plant Inventors

The small size of the plant bonus fund for the introduction of new technology, regulations requiring that any reward for invention be added to production costs,[4] and lack of interest on the part of the management in innovations - all these adversely affect initiative even among some talented workers. V. Bush, a worker at VEF Plant in Riga, was praised for numerous inventions he made.[5] At first he was given a group of skilled workers to help him in implementing his ideas. However, under the pressure from the production plan the workers were returned to the mass production operations and Bush himself was frequently redirected from his creative work to performing routine work.[1] Not always was he paid for his inventions, a reward to which he was entitled under the law, and eventually he quit his inventive work and switched completely to routine work, which increased his earnings by 60 %.[2]

---

[1] Z. Skopina and J. Feldman, "Fiansovye metody stimulirovaniia nauchno-tekhnicheskogo progressa," Finansy SSSR (No. 4, 1971), pp. 50-55.

[2] Ibid.

[3] Garetovskii, "Finansy: Nauchno-tekhnicheskii progress."

[4] V. Zakharov, V. Medvedev, and N. Iashen'kin, "Nekotorye problemy stimulirovaniia tekhnicheskogo progressa," Kommunist (No. 4, 1972), pp. 41-50.

[5] I. Golembiovskii, "Formula Busha," Izvestiia, January 26, 1972, p. 3.

4. Initiative vs. "Wait and See"

Therefore, if plants do introduce new technology they attempt to limit this to a small scale so as not to affect the total annual budget of the plant.[3] As a result of these pressures to hold down the amount of technological innovation, the impact of plant R & D on the economy as a whole is severely reduced.[4]

L. I. Brezhnev in his speech at the 24th Congress of the CPSU stated:

---

[1] V. Gerbachevskii, "Vol'demar Bush ukhodit," Literaturnaia gazeta (No. 5, 1973), p. 10.

[2] Ibid.

[3] A. Strazhev, "Ot idei do konveiera," Pravda, July 5, 1971, p. 2.

[4] Ibid.

> To eliminate the existing difficulties we should create conditions compelling enterprises to manufacture the latest types of products, to literally chase after scientific and technical novelties and not to shy from them, figuratively speaking, as the devil shies from holy water. Those collectives, that really fight for modernising plant and production processes, for producing output meeting the latest demands, should be put in a more privileged position.[1]

However, under the existing rules, it is the enterprises that opt for the "wait and see" attitude that gain most, while those who display more initiative and are anxious to be at the head of technological progress are being punished. Under the rules the enterprise or organization that uses an invention first pays for it. It also has to expend substantial resources, something inevitable in the course of assimilation of new product: production of prototypes, testing, experimenting, etc. When all the troubles are over, other enterprises could use the inventions and reap the economic benefits without spending too much money.[2] Therefore, to be pioneer in the introduction of new technology in such conditions does not pay.[3] In many cases the long time taken to introduce even the most important inventions into production could be explained exactly by this factor.[4]

---

[1] Materialy XXIV s'ezda KPSS, (Moskva: Izd-vo politicheskoi literatury, 1971), p. 56.

[2] Kotanian.

[3] Ibid.

[4] Ibid.

In view of this, a remarkable change is taking place in the attitude of Soviet economists. They suggest to change the existing regulations in such a way as to make enterprises using tested results cover part of the expenses incurred by the pioneer plant.[1] This could be achieved by pioneer enterprises patenting their inventions and selling licenses for their inventions, commercial models, etc.[2]

This is remarkable, because this suggestion, if accepted, would throw out one of the dogmas of Soviet political economy, which claimed that the ability of all Soviet enterprises to use the results of work of any one of them free of charge was one of the advantages of Soviet economy over capitalist economy. Experience shows rather that the opposite is the case.

D. New Forms of R & D

1. Industrial-Production Comines (PPO)

The current drive in the Soviet Union to utilize the latest achievements in science and technology has taken the form of even greater concentration of production by encouraging the establishment of new ob'edinenila (combines). The first combine was set up in L'vov in early 1960's, from where this trend spread out to other parts of the country. In most cases the creation of combines has been nothing else but ordinary mergers, thus enabling enterprises in the same branch of industry to rationalise their production, to improve their cooperation and specialisation, to reduce the cost of production and to pay more attention to research and development, as well as to produce other benefits which a merger is usually expected to bring about. Such mergers are called in the Soviet Union the promyshlenno-proizvodstvennie ob'edineniia (PPO or industrial-production combines).[1]

---

[1] Ibid.

[2] Ibid.

2. Production-Technological Combines (PTO)

Of more interest are the proizvodstvenno-tekhnicheskie ob'edineniia (PTO or, production-technological combines), which are the arrangements intended to overcome those barriers to innovation which exist between research and development establishments and industrial enterprises, by bringing together research, development and production into a single organization, one which possesses large facilities of its own for carrying out major R & D projects.[2] To bring this about, research institutes will be placed under factory control. Under this scheme, the role of branch research institutes would be limited to more theoretical work where results would be difficult to predict, while the factory would carry out all production-oriented research and be responsible for all stages in the development of a new product or process. It is hoped that this arrangement would eliminate existing delays when projects are transferred from development organisations to industrial enterprises and would overcome other related deficiencies in the present system such as inaccurate and inapplicable documentation which requires substantial changes.

---

[1] I. N. Kuznetsov, Proizvodstvennye ob'edineniia i effektivnost' proizvodstva (Moskva: Izd-vo "Znanie," 1971), p. 31.

[2] Ibid.

Up to now only a few large combines with large scale research as well as development facilities have been established. The most well known examples are Elektrosila in Leningrad and Uralmashzavod in Sverdlovsk. Elektrosila is a large combine with substantial R & D facilities which include an affiliate of the All-Union Electromechanical Research Institute and its staff of 1500.[1] The affiliate is in charge of all R & D activities within the combine. Although the affiliate is technically a branch of the Electromechanical Institute, in practice it is independent and forms an inseparable part of the enterprise. Since 1963, when the combine first came into existince, the affiliate has developed 146 new machines, all of which have been introduced into production without difficulty.[2]

Another prominent example of a combine is Uralmashzavod, to which the Research and Design-Technological Institute for Heavy Engineering is subordinated. The plant acts as the production base of the institute.

---

[1] P. Abroskin, "Sovershennye machiny-osnova tekhnicheskogo progressa," Kommunist (No. 1, 1965), pp. 46-55.

[2] A. Molchanov, "Novoe vo vnedrenii novoi tekhniki," Ekonomicheskaia gazeta (No. 47, 1966), p. 16.

Elektrosila and Uralmashzavod are really giants and showpieces of Soviet industry. The more common type of combine is much smaller and less integrated than these two. These combines nevertheless provide great advantages with regard to technical innovations. A good example of this arrangement is the Leningrad combine Svetlana that was established in October, 1962; it consists of five factories, five experimental-design bureaux and two affiliates of the head plant. It specialises in producing electrovacuum and transistor instruments. Apart from the factories manufacturing its main products, the combine has a glass factory producing semi-finished goods for the main production, and a design and production base in machine building which provide necessary conditions for development and production necessary for the combine's new technological equipment. Such an industrial structure has created the basis for a quick solution within the enterprise of a large number of planning and production problems, and it increases Svetlana's responsibility for the quality of its product and the fulfillment of the state plan.[1]

In 1966 Svetlana was granted the status of Chief Administration in its ministry and it was accountable directly to the Deputy Minister, thus eliminating one intermediate level of management (ministry - cominbe, instead of ministry - chief administration - enterprise).[2]

---

[1] A. A. Allakhverdian (ed.), Khozraschet i upravlenie (Moskva: Izd-vo "Ekonomika," 1970), p. 114.

[2] Ibid, p. 115.

The technological and production development of Svetlana is proceeding at a high rate. During six years (1963-1968) the production capital stock of the combine increased 1.9 times, while that of the experimental and design bureaux rose by 3.3 times. The corresponding increase in the number of personnel for the same period was 10.3 % and 30.7 % respectively.

The period required for development, designing, and producing prototypes, and putting new products into mass production has been reduced from five to three years. All new instruments in mass production have been classified as equal to the world level.[1]

3. Science-Production Combines (NPO)

Other possibilities have been opened with the establishement of science-production combines (*nauchno-proizvodstvennye ob'edineniia* - NPO). The first such groups are set up in Moscow and Leningrad - the groups *Pishchepromavtomatika*, *Pozitron* and *Plastpolimer* and some others. Unlike *Elektrosila* and *Uralmash*, it is the research institutes that are in charge of such groups. They consist of large research institutes, well-equiped design bureaux and powerful industrial enterprises. Naturally, in such conditions research, development, designing, production of prototypes and introduction of them into mass production have become united under one single plan.[2]

---

[1] *Ibid*.

[2] K. Tasik, "Nauchno-proizvodstvennye ob'edineniia," *Voprosy ekonomiki* (No. 11, 1972), pp. 40-52.

In the group Plastopolimer the researchers are able simultaneously with the development of a new technological process to test technology in experimental-industrial production. The loss of time between various stages of development and introduction into production is reduced to a minimum. Recently the group has developed in a short time new progressive methods of polistirol production.[1]

Unlike most combines, the NPO is a branch research organization, whose task is to lead research and development to the final stage of industrial production and a full assimilation of new technology, first at its own plant and then on all plants of their branch of industry. They differ from the PTO's, such as Elektrosila, Svetalana and others in that their aim is to increase the technological level and efficiency in their branch of industry, while research institutes and design bureaux incorporated into the PTO's work, as a rule, only for their own group.[2]

As it was said earlier, the first combines appeared in the early 1960's. In 1965 there were already about 600 combines that were producing over 5 % of the total industrial production of the country.[3]

---

[1] Kuznetsov, p. 32.

[2] Ibid.

[3] Ibid.

By far the greatest success of the combine movement was achieved in Leningrad, where in 1971 there were 56 combines consisting of 230 industrial enterprises and 40 research institutes and design bureaux, with one quarter of Leningrad industrial personnel, and manufacturing about one third of the city's industrall output.[1]

4. Old Diseases in New Organizations

On the nation-wide level, however, the result was much more modest. Despite the first encouraging results of their performance, their number by 1971 was just over 600 with about 8 % of the country's industrial output.[2] During the 1966-1970 Five-Year Plan some 200 new combines were established and about the same number of them was disbanded or reorganized for various reasons.[3] Among the disbanded were Mosstankoliniia, Vitebsk Stankoob'edinenie and Orenburg Gidropress[4] - all three from the Ministry of Tool and Tooling Industry.

A particularly high proportion among the disbanded units were those in which their composite factories had managed to retain a considerable autonomy, for it was in such groups that it was particularly difficult to unite production and technological processes of separate enterprises into a single technological process within the framework of a new industrial complex.

---

[1] P. Pavlov, "Intensifikatsia proizvodstva i trudovye resursy," Voprosy ekonomiki (No. 3, 1972), pp. 15-21.

[2] Kuznetsov, p. 22.

[3] V. Gromov, "Kontsentratsiia proizvodstva i sovershenstvovanie ego form," Kommunist (No. 17, 1971), pp. 44-55.

[4] Kuznetsov, p. 30.

There are also other reasons why some combines have been disbanded. It was not rare that large groupings were formed in a purely administrative manner, just to follow the current fashion. As a rule, individual enterprises did not initiate mergers and sometimes even resisted their implementation.[1] Mestnichestvo (localism) is again blamed for such behavior. This trend was supported by the fact that the branch chief administrations in industrial ministries continued to run the factory-components of the *ob'edinenie*, ignoring the general management of the group. Because of very limited rights given to new combines and consequent heavy dependence on the~~ir~~ chief administrations, the creation of such groups in some cases turned out to be one more stage in the ministry - production unit system, thus complicating instead of simplifying the management process.[2] That practice of course put up serious obstacles to the process of a steady merger of the component enterprises. There were cases when local authorities tried at any cost to return within their jurisdiction some factories as independent industrial units or resisted their inclusion into a combine, if management of this group was in another economic region. As a result of their efforts many healthy combines were disbanded in 1965-1966.[1]

---

[1] Gromov.

[2] G. Seidov, "Stanovlenie proizvodstvennykh predpriiatii," Ekonomicheskaia gazeta (No. 51, 1972), p. 14.

A closer cooperation of enterprises within the framework of the combine is also prevented by the continuing practice of the central planning and financial organizations to give the plan for basic production and technological indicators to each enterprise, thus emphasizing their autonomous status even in new economic conditions. All this led to a situation in which , during the last three to four years most newly-formed combines were those where each individual factory retained its economic and juridical independence.[2]

In a number of cases the management of new groups formulated its goals in very general terms (for instance, to secure scientific and technological progress in general, planned and balanced development of the whole industrial-economic complex, etc.). Under such circumstances the management can put the burden of attaining such goals on the shoulders of the component units. In other words, the combine in such a case turns simply into an administrative organ, duplicating to a large extent the functions of the ministerial chief administrations.[3]

---

[1] Gromov.

[2] [illegible]uznetsov, p. 33

[3] *Ibid.*

Despite its new form, the combine could not escape the reality of Soviet industrial life. The total output is still the chief indicator of the enterprise 's success. Even after the inclusion of research and design organizations into combines the system of success indicators has remained the same as for any other industrial plant.[1]

Analysis of the current planning of new technology in combines shows that the plans of new technology are not connected with the plans of industrial output. This is explained to a large extent by the fact that the plans for new technology are being considered by the higher organizations for a long period of time, often for 8 to 9 months.[2] For instance, the plans for new technology of the two Leningrad combines - Sverdlow Machine Tool and Karl Marx Machine-Building - for 1971 were not yet ready in March of that year, due to the delays by a higher organization. Under such conditions combines are unable to connect the general economic indicators with their plans for new technology.[3]

The operation of NPO does not proceed smoothly either. They complain that even the enterprises that have been "fixed" for them to put to mass production the results of their work, refuse to do so for lack of economic incentives.[4]

---

[1] V. Andreev and G. Kipermann, "Planirovanie i stimulirovanie tekhnicheskogo progressa," Voprosy ekonomiki (No. 1, 1972), pp. 69-78.

[2] Ibid.

[3] Ibid.

[4] M. Zapisov, "Nauchno-Proizvodstvennye ob'edienie; opyt i problemy," Ekonomicheskaia gazeta (No. 7, 1973), p. 8

5. Intermediate Organizations

It is universally admitted in the Soviet Union that the introduction of new inventions into production is the main bottleneck between science and production. This problem is particularly acute on the borderlines between different branches of technology. The Soviet press gives many examples of the lack of coordination and collaboration between research and development organizations which have for years been unable to agree on concerted action in the development of new technology.

In response to the need to speed up the utilization of the achievements of science and technology a number of R & D intermediate organizations of a new type began to appear a few years ago - in Baku, Novosibirsk, Leningrad, Tomsk, Krasnoiarsk, Riga, Vilnius, Sverdlovsk and Severodonetzk.[1]

a) Success of Their Operations

The usual path of production innovation from academic institute - to branch institute - to design bureau - to experimental production facilities - and then to the industrial enterprise has many breaks in it and is beset with lack of coordination, and endless consultations and efforts to escape responsibility if something goes wrong. The result is long delays in the introduction process.

---

[1] P. Volin, "'Khikmet' - eto znachit modrost'," Literaturnaia gazeta (No. 24, 1971), p. 10.

In order to meet this problem, a new type of organization, the firm, has been experimented with. These new firms are right at the junction between science and production. Moreover, their staffing is based not on an "ironclad" staff list, but on the subject matter of the research. The firms keep almost no one "in reserve", rather they call in whoever is necessary. Thus in a sense they have no staff, but at the same time their staff is practically unlimited. This ensures minimum costs.[1]

In contrast to most research and design organizations these firms operate on the basis of full economic accountability. Their existence is determined not by reports, but by their output. They cannot afford the luxury of working on a useless or dubious project or not taking seriously their commitments. Of course, they make mistakes too but their reaction to such happenings is very much different from practically all other Soviet R & D organizations. When one of these firms learned that its design had proved unsatisfactory, it immediately returned the entire fee to the client - something unheard of in the rest of the Soviet R & D world.[2]

The popularity of the firms is such that, for example, the Novator firm in Baku was able to accept only 10 % of the orders received and was besieged with orders from clients in Azerbaidzhan, Moscow, Leningrad, Kiev and Tyumen'. The activity of Khikmet - another similar firm in Baku - saves the country 10 million rubles a year. It has completed projects in about four months that prestigious research institutes asked five years to complete, while its regular staff numbers only 16.[1]

---

[1] Ibid.

[2] Ibid.

The results of another firm, Fakel, in Novosibirsk that was dealing with similar matters have been reported to be extremely good too.[2] And yet they had to be closed.

b) Reasons for Closure

The trouble is that such firms have powerful opponents - the banking and finance agencies, which have influenced other organizations to withdraw their initial support for the firms. The strongest argument of the financial officials is that the extra income earned through the firms is unplanned and violates market proportions. This was denied by Khikmet, whose members earned an average of only 60 to 70 rubles a month. But the excellent results of the firms bring into question the existing rules and instructions themselves. Another accusation is that those who work for firms twiddle their thumbs all day at an institute, then rush off to make money at the firm.

This might be interpreted as a clear admission that pay at the institute is determined primarily by position, degree, title, working hours, etc., whereas at the firm it is final results that count.

---

[1] Ibid.

[2] I. Foniakov, "Pochemu zatukhaet 'Fakel'," Literaturnaia gazeta (No. 26, 1970), p. 10.

But nothing has helped. In spite of the excellent results of the firms, and strong support given to them by Literaturnaia gazeta, they were doomed. Khikmet and the pioneer of this movement, Fakel, have been closed. Novator has survived, but was subordinated to the Azerbaidzhan Congress of Trade Union, an arrangement that is bound to dampen a lot of sparkling initiative and enthusiasm of the firm - perhaps its main asset. The fate of other similar firms is not clear, but the issues and controversies that surrounded them were similar to those of the Baku and Novosibirsk firms, and it may be assumed that at least some of them have found themselves in a similar situation. This is yet another example of the inflexibility of the administration that found it appropriate to put an end to the activities of the groups which had produced remarkable results in the area they are most needed, because their way of operations did not fit the existing system. The determination to keep everything within this secure administrative grip poves to be stronger than any economic benefits.

E. Prices

1. Profit as Success Indicator in the Soviet Union and the West

Of all the obstacles preventing a more rapid introduction of the last achievments of science and technology into production, by far the largest obstacle lies in a chaotic price structure of Soviet economy.[1]

---

[1] Gertrude E. Schroeder, "Soviet Technology : System vs. Progress," Problems of Communism, XIX (September - October, 1970), pp. 19-30.

The Soviets are in a more difficult situation than, say, American firms are. The American firms usually rely on profit as the main indicator of their performance. Profit provides a general indicator that reflects all aspects of economic performance. As long as the existing prices reflect supply and demand, profit is a fairly accurate criterion for determining how well the firm plays its role in economic life.

In the Soviet Union, however, the administration of the economy cannot rely only on profit as the best indicator for judging the performance of the plant. Maximizing profit at the enterprise level under a price system that does not reflect supply and demand often runs counter to the interests of the economy as a whole. It is not rare that some vital commodities are sold at a price that is below cost, while other items have prices that greatly benefit their manufacturers. In these circumstances to rely on profit maximization would result in disequilibrium between supply and demand. Therefore the Soviet planners have to prepare production plans for enterprises in great detail.[1]

2. Price-Setting

Most prices in the Soviet Union are set by Gosplan, others by the ministries and some are set by the enterprises themselves. The main problem is how to set prices for new products that are high enough to induce producers to manufacture them, but at the same time low enough to have demand, so to insure rapid replacement of old technology by new.[1] All available Soviet data indicate that striking this balance is still beyond the reach of Soviet planners and economists.

---

[1] This discussion is based on Robert W. Campbell, Soviet Economic Power (Boston: Houghton Mifflin Co., 1966), p. 80.

Old technology continues to reward its makers more generously than any new technology normally could offer, because the existing prices do not reflect the growing obsolescence of the products in mass production. A survey made by the All-Union Institute of Transformer-Building produced startling findings. In comparison with the new models of the second year of production, the old models of transformers after 10 years of their production were more profitable by 14.3 % and after 15 years - by 23.2 %.[2] Therefore the longer a product in mass production the more profitable it is for the enterprise.[3]

3. Artificially High Profitability

The present high profitability of many enterprises is often blamed for the plants' reluctance to start producing new items. The profitability level in machine-building industry in 1969 was 24.3 %;

---

[1] P. Bunich, "Ekonomicheskoe stimulirovanie proizvodstva i novaia tekhnika," Voprosy ekonomiki (No. 10, 1972), pp. 15-25.

[2] L. Gatovskii, "Ekonomicheskaia zainteresovannost' predpriiatii v novoi tekhnike," Voprosy ekonomiki (No. 2, 1972), pp. 6-19.

[3] Ibid.

light and food industry - 28.2 %; electrical machine-building - 35.6 %; means of automation - 52.5 %.[1] Even when a new product gives profit, it is still below the profit of the old products. The profitability of new types of products in electrical engineering is on average 14 - 15 %, while the required level by the ministry is 24 %.[2] The inordinately high profitability of certain enterprises is due not only to the lowering of expenditures, but also to a deliberate exaggeration of expenses incurred by the enterprise for its investment into new products and processes and to presenting mass-produced items as a single order production.[3] Because of this, one comes across a profitability of 140 - 200 % (10 to 15 times higher required profitability) on many products manufactured by the Elektropribor plant in Groznyi.[4]

4. Rise in Prices for New Technology Higher than the Rise in Productivity

Technology is important not in itself, but as a labor-saving means, a means of improving labor productivity. It is argued that society's outlays on large investments, representing a diversion of resources from the expansion of today's consumption, is justified only if this spending is less than the value of goods produced as a result of this investment. But the fact is that the present rise in price for new technology is much faster than the resulting rise in productivity. Therefore this investment is not justifiable as a rational economic investment.

---

[1] Ibid.

[2] A. Vikhliaev, "Uroven' rentabel'nosti," Ekonomicheskaia gazeta (No. 30, 1970), p. 17.

[3] Ibid.

[4] Gatovskii.

During the last ten years the Ministry of Chemical and Oil-Machine-Building increased the prices for many of its products 2 to 3.5 times, with only small technical improvements for these products.[1] The rise in prices for new machinery in the woolen industry was 4 times higher than the growth in productivity of new machines in comparison with the old.[2] Therefore, without pressure from above, the enterprises are not eager to buy new products because enthusiasts for new technology will be doubly punished: new items not only contain imperfections, but they are also very expensive.[3]

Some enterprises, utilizing the current rapid rise of prices for new technology, simply change the names of their old products and greatly increase their price. For instance Tochelektropribor plant in Kiev renamed its control instrument from KIP to K-50 and raised its price five-fold; by simply renaming another instrument from D-533 to D-566, it put up the price by 50 %.[1] Press reports suggest that this outright abuse of the confused price situation is being practized not only by some enterprises but also by whole ministries.[2]

---

[1] Efimov.

[2] Gatovskii.

[3] Ibid.

The new reduction of wholesale prices by 11 % on January 1, 1972[3] is not likely to bring about "law and order" into the Soviet price system, because there is no substitute for the interplay of supply and demand. As Academician Rumiantsev wrote:

> Unfortunately, there is still no effective economic mechanism which, on the basis of the state plan and in complete accordance with it, would influence the economic interest of enterprises in such a way that they themselves would be economically compelled to produce and incorporate new equipment. This mechanism must produce those conditions whereby all cost-accounting indices of the work of enterprises would be made fully dependent on the degree and intensity with which they renovate their production apparatus as well as their product mix.[4]

F. Conclusion

Because of the leading role given to outside R & D organizations in implementation of the national R & D program, plant R & D is in the backwater of technological progress. The plants themselves are very reluctant to introduce inventions and innovations, especially on a large scale, because this could jeopardize their production plans on which depend the earnings of the workers and management. As things stand now, those plants that display greater initiative in technological progress are financially disadvantaged in comparison to those which adopt the policy of "wait and see."

---

[1] V. P. Krasovskii, Planirovanie i analiz narodno-khoziaistvennoi struktury kapital'nykh vlozhenii (Moskva: Izd-vo "Ekonomika," 1970), p. 242.

[2] P. Buderkin, "Effekt vnedreniia," Izvestiia, March 4, 1972, p. 3.

[3] V. K. Sitnin, "Tekhnicheskii progress i tsenoobrazovanie," Ekonomicheskaia gazeta (No. 32, 1972), p. 7.

[4] Rumiantsev.

In order to overcome these shortcomings, a campaign for setting up combines was launched. However, the combines were only partially successful. The old ills of the traditional order - frequent interference from the ministries, delays with approval of plans for new technology, lack of incentives - are all present in the combines. High hopes raised by the very encouraging results of the intermediate firms were dashed, because of the firms' unorthodox way of operations.

Perhaps, by far the greatest obstacle involving enterprises in a more active introduction of new technology lies in the administrative price fixing that does not take into account the relative scarcity of goods. The truth of the matter is that there is still no effective economic mechanism that would give enterprises sufficient incentives to develop and produce new technology.

CHAPTER VII

CONSTRUCTION

A. Importance of Construction in Technological Progress

When a new product or technological process is being introduced, reconstruction and expansion of existing plants or construction of new ones is often required. Construction presents one of the major obstacles to technological progress in Soviet industry. Some 30 % of the blame for failure by ministries to fulfill their plans for the introduction and assimilation of new technology has been put on the construction industry, which did not complete on time many projects where new technology was supposed to be produced.[1]

B. Unsatisfactory Structure of Investment

Of all the branches of Soviet industry perhaps no other branch has been so severly and often criticized as the construction industry, and yet there is from the official point of view no sign of any satisfactory improvement. In the sphere of material production the Soviet Union is now building more than any other country in the world.[2] In the words of L. I. Brezhnev, General Secretary of the Communist Party of the Soviet Union:

---

[1] Klinskii and Oznobin.

[2] Materialy XXIV s'ezda KPSS, p. 62.

> The problem is that we are investing enormous sums of money while the returns are not fast enough and, consequently, smaller than they should be.[1]

Brezhnev's dissatisfaction over the returns on investment is understandable. At present machines and equipment make up only 34.8 % of all productive capital stock in the national economy and 38.2 % in industry.[2] These figures are relatively low. In the USA for example, the cost of machines and equipment of the total capital stock in industry is 55 %.[3] In the USSR the proportion of investment devoted to new construction is 40 % and for expansion, reconstruction and technological reequipment - 60 %, while the corresponding figures for the United States are 20 and 80 %.[4]

C. Scattering of Resources over Excessive Numbers of Projects

There are a number of reasons for this. One is that when plans are drawn up they frequently envisage excessively large numbers of projects without taking real possibilities into account. As a result, funds are scattered, the number of unfinished projects grows, and large resources are frozen.[5] Academician T. Khachaturov stated that the estimated cost of major construction projects that entered the approved list of construction projects (Titul'nye spiski) for 1970 was 168.2 billion rubles, while the allocated sum for that year was only 14.1 billion rubles. Simple comparison of these figures shows that the average length of time for the completion of the projects would be 12 years.[1]

---

[1] Ibid, p. 63.

[2] Garetovskii.

[3] Ibid.

[4] Ibid.

[5] Ibid.

In the period of 1958-1968 there was a large increase in the number of projects under construction. Their calculated cost more than doubled, while the allocation of capital investment went up only by 25 %.[2] This situation was even more aggravated by the reallocation of capital investment in the chemical industry and a number of other industries related to it, which led to a reduction of resources for completion of major projects started earlier in other branches of industry.[3] Annual revisions of the approved projects during their construction leads to extra cost and creates numerous problems in inter- and intrabranch planning in Soviet industry.[4]

---

[1] T. Khachaturov, "Povyshenie effektivnosti obshchestvennogo proizvodstva," Voprosy ekonomiki (No. 4, 1971), pp. 18-30.

[2] L. M. Smyshlaeva, Struktura kapital'nykh vlozhenii i ikh fakticheskaia effektivnost' (Moskva: Izd-vo "Nauka," 1970), p. 149.

[3] Ibid.

[4] A. Ambarzumov, "K voprosy o sovershenstvovanii planirovania kapital'nykh vlozhenii," Voprosy ekonomiki (No. 2, 1971), pp. 118-23.

D. Increase in the Number of Unfinished Projects

The volume of incompleted construction in Soviet economy in 1968 doubled in comparison with 1960. In industrial construction that volume more than doubled for the same period. An especially large increase in the number of unfinished projects was in chemical industry - 2.8 times, machine-building - 2.3 times, paper and pulp industry - 2.1 times.[1] Soviet sources have to admit that the time required to build and commission new plants is generally longer than in Western countries, and especially in the USA and Japan.[2] The average time period of completion of industrial projects is between 4.5 and 5.6 years, or almost twice[3] as long as required by the state construction norms.[4]

These are average figures. However, the Soviet press gives numerous examples when the periods of construction of individual factories last much longer. Since 1964 the Ministry of Light Industry of the RSFSR has not been able to complete the construction of a weaving factory in Morshansk, Tambov Region, and its completion is expected only in 1972; the plan called for completion in 2.1 years. The norm has been exceeded four times.[1] According to the latest data a new deadline for the completion of the factory is 1973, but even this is in doubt.[2]

---

[1] Ibid., p. 147.

[2] Gatovskii, Problemy ekonomicheskogo stimulirovaniia nauchno-tekhnicheskogo progressa, p. 103.

[3] These figures differ greatly from the average construction time of industrial projects given by A. Ambarzumov. The latter states that the average period is between 7 and 12 years. A. Ambarzumov, "K voprosy o sovershenstvovanii planirovaniia kapital'nykh vlozhenii," Voprosy ekonomiki (No. 2, 1971), pp. 118-23.

[4] Lebedev, p. 60.

From 1965 the construction of Maklakovskii canifol-extrusion plant of the Ministry of Paper Industry has been underway. Its completion is expected in 1972; the plan called for three years.[3] Of 25 enterprises investigated by the Laboratory of the Construction Bank of the USSR (Stroibank) in 1968, only one, No. 52 Garment Factory in Moscow, was finished close to schedule - 28 months instead of the planned 24 months. In all other cases the actual time was two or three times longer than planned.[4]

Even when statistical agencies receive reports on the completion of new industrial projects, they are not sure that it is actually the case. A random survey carried out by the USSR People's Control Committee and the Central Statistical Office of the USSR in the fourth quarter of 1971 revealed 130 cases of false reporting on completion of new projects by various ministries.[1] In order to present a satisfactory picture ministries and their commissions accept unfinished projects, which then stand idle for long periods of time because many things still have to be done to start production, while construction organizations, once their job is accepted, are in no hurry to finish their "finished" projects.[2] Therefore many writers point at the construction industry as one of the major areas where they could speed up economic development of the country.

---

[1] F. Manoilo, "Kapital'noe stroitel'stvo i zadachi Stroibanka v novoi piatiletke," Finansy SSSR (No. 7, 1971), pp. 3-10.

[2] V. Komov, "Vereteno v parke," Izvestiia, June 8, 1972, p. 3.

[3] Manoilo.

[4] V. Bard and R. Rybakova, "Effektivnost' kapital'nykh vlozhenii v promyshlennosti i istochniki ikh finansirovaniia," Finansy SSSR (No. 2, 1972), pp. 46-51.

E. New Construction vs. Reconstruction

Another point of criticism is the irrational distribution of a considerable part of the capital investments. Experience shows that, as a rule, it is economically more profitable to ensure a growth of production by reconstructing and technically modernising factories. But a very large share of the funds is still channelled into new projects and a relatively small share is used for the modernisation of production and the renewal of plant. Despite the strong condemnation of this practice by the Communist Party, the Government and many experts, the share of expenditure on reconstruction even went down from 61 % in 1959 to 59 % in 1969.[3] This trend was especially marked in machine-building, power and electrical industries, and light industry.[4] When reconstruction is undertaken, it is as a rule faced with long construction periods. For instance, reconstruction of the Ural Automobile Plant was decided upon in 1967 and the work started in 1969, with an estimated total cost of 85 million rubles, but with only 7 to 8 million rubles for annual allocation, which would have assured that the reconstruction would continue for 10 to 12 years minimum. Yet, even these plans are not being implemented: The spending for 1969 was 5.7 million rubles, for 1970 -, 6.3 million, and less than 6 million 1971.[1] Despite all pleas from the plant management the Ministry has refused to allocate more.[2]

---

[1] A. Frolov, "Moshchnosti na bumage," Izvestiia, July 18, 1972, p.3.

[2] Ibid.

[3] I. Sher, "Finansovye problemy kapital'nogo stroitel'stva v deviatoi piatiletke," Finansy SSSR (No. 2, 1972), pp. 53-63.

[4] Ibid.

The Automatic Compressor Plant in Panevezhitse, of the same Ministry, is also being reconstructed. It started in 1967 and was supposed to be finished in 1970. However, by the end of 1970 only 2.95 million rubles were given by the Ministry out of the total of 11.6 million rubles. Not surprisingly, the reconstruction was not finished in 1971 either.[3]

F. Manoilo, Chairman of the Construction Bank of the USSR gives the following picture of the way another ministry carries out the reconstruction of some of its plants: The Ministry of Ferrous Metallurgy has been reconstructing for several years three of its enterprises, Svobodnyi Sokol, Omutinskii Plant and Beloretskii Metallurgical Combine.

---

[1] S. Bunkov, "Na tormozakh," Izvestiia, February 3, 1972, p. 3.

[2] Ibid.

[3] Bard and Rybakova.

Under the 1971 construction plan the reconstruction which was to be carried out at Svobodnyi Sokol amounted to 2 %, at the Omutinskii Plant - 2 % and at Beloretskii Metallurgical Combine - 4.5 %. Such reconstruction could continue for decades.[1]

Although the Government now puts emphasis on reconstruction of existing plants, rather than construction of new ones, this is not always economical. This is particularly true in light industry. At present a substantial proportion of light industry enterprises are housed in the buildings constructed in the last century with a small height for each storey (not higher than three meters). Equipment is crammed into these buildings, and the existing narrow passages prevent the use of mechanized transportation. The existing systems of ventilation, lighting and support shops are inadequate for modern equipment. That is why large parts of capital investment earmarked for the reconstruction of such enterprises goes not for the replacement of productive capital stock, but for construction and drastic reconstruction of buildings, warehouses, communication systems, support shops, etc. As a result of this, and a blind following of the instruction sent from the top, capital investment per unit of output growth at the reconstructed factories of light industry is 2 to 2.5 times higher than at the newly built factories.[2]

---

[1] Manoilo.

[2] Krasovskii, p. 179.

F. Faulty Estimates

There are also major shortcomings in project designing and construction itself. It has become usual that the approved cost estimates of construction projects will be 1.5 to 2 times lower than the actual cost.[1] On top of this, in the process of approval the cost estimates are trimmed even more in various committees because of alleged and real, unnecessary features, and it is rare that the plans are corrected in a way which would put the estimates and actual cost closer to each other.[2]

This practice of underestimating costs is stimulated by the fact that once a project has started there is always a possibility of obtaining extra funds to finish it. A recent check-up has established that the estimated cost of 260 major construction projects included in the 1972 plan has increased by 47 % over the cost figures indicated earlier in the confirmed lists of approved projects.[3] This brings disorder into the planning of capital investment programs and does great harm to the state.[4] Soviet sources put this in sharp contrast with the practice in the Western countries where, they claim, no matter how wrong calculations are, a construction firm will not get more money than is written in the contract. This is, of course, far from being the case. The problem of underestimating and seeking extra payment when miscalculations surface in the West is acute too, although perhaps not so much as in the Soviet Union.

---

[1] Gatovskii, Problemy ekonomicheskogo stimulirovania nauchno-tekhnicheskogo progressa, p. 105.

[2] Ibid.

[3] I. T. Novikov, "Stroit' bystree i ekonomichnee," Pravda, August 15. 1972, p. 2.

[4] Ibid.

Because of lack of coordination between the designers, builders and industry, documentation and blueprints often come late and with numerous mistakes, correction of which usually increases the time and cost of construction.

The bonus system which encourages designers to produce the best technical and economic parameters often pushes them into making unrealistic planning and designing, with serious consequences for the whole economy.[1]

G. Low Level in Designing

The quality of industrial projects is the key in the effectiveness of capital investment. Practice shows that wrong location of new projects, low level of designing, inclusion of obsolete technology, inefficient equipment, impractical layout and, finally, mistakes and miscalculations lead not only to the lengthening of the time of construction and commissioning of enterprises and of reaching the designed parameters, but also to substantial overspending in capital investment. According to data of the State Expertise of Gosstroi (Chief Construction Administration), out of 4,345 projects submitted for approval, 785 were returned for redesigning, and some were completely rejected.[1] Of 103 major construction projects submitted for approval to the Council of Ministers in 1964, 29 were returned for major redesigning for various reasons.[2] This situation has even been aggravated with time. According to I. T. Novikov, Vice-Chairman of the USSR Council of Ministers and Chairman of the State Construction Committee, at present about one-third of the experts' designs are returned for further work because of their low level.[3] Among them are the designs for the third unit of the Nizhnekamsk Petrochemical Combine, the Leninabad Synthetic Fibres Combine, the second unit of the Polotsk Chemical Combine, as well as others.[4]

---

[1] Gatovskii, Problemy ekonomicheskogo stimulirovania nauchno-tekhnicheskogo progressa, p. 106.

Such factors adversely affect the achievement of required capacity and other parameters of newly built plants. Accroding to the Central Statistical Administration of the USSR in 1965 out of 507 enterprises commissioned 2 years and more before, only 12 reached their designed working capacity.[1] (Two years is regarded as normal time for this.) Project and design organisations are not responsible for such an important stage as reaching the designed quantitative and qualitative parameters of new projects and do not participate in the work at this important stage.[2]

---

[1] M. T. Meleshkin, A. P. Sidorov and I. A. Chervenko, Uskorenie osvoeniia moshchnostei v promyshlennosti (Moskva: Izd-vo "Ekonomika," 1967), p. 4.

[2] Ibid.

[3] Novikov.

[4] Ibid.

H. Low Labor Productivity in the Construction Industry.

The builders themselves are often accused of insufficient use of new, modern materials and building components, poor workmanship, still inadequate mechanization of construction process.[3] Labor productivity in Soviet construction industry is 60 % of the American construction industry, according to Soviet sources.[4]

In recent years there has been almost no decline in lost working time, workers in a number of occupations have not increased output in terms of physical units, and an extraordinary amount of labor is still wasted in auxiliary loading and unloading operations and in correcting and eliminating substandard work.[5]

---

[1] M. T. Melechkin, A. P. Sidorov and I. A. Chervenko, p. 5.

[2] Ibid.

[3] Materialy XXIV z'ezda KPSS, p. 63.

[4] P. A. Khromov, "Proizvoditel'nost' truda v narodnom khoziaistve," Voprosy ekonomiki (No. 1, 1971), pp. 132-34.

[5] I. Dmitriev, "Stroit' bystro, ekonomichno," Pravda, February 15, 1972, p. 2.

No less important is a very low level or even total absence of knowledge among construction engineers about the economic aspects of their own work. A survey carried out at an industrial construction project found that of 23 questioned engineers only one could answer something on the possible gains in shortening construction period.[1]

I. Misuse of Funds for Industrial Construction

At the same time there are numerous cases of violation of rules and regulations in spending on construction. The Ministry of Power of the Uzbek SSR obtained approval to construct a unified control centre at the cost of 2.5 million rubles. When the Commission of the Construction Bank (Stroibank) investigated the construction plans, it found that only 30 % of that sum was needed for the control centre, while the rest would have gone for a number of administrative buildings under the same roof.[2]

Once permission is given to build new projects, ministries and local organizations try to do at the same time something else under the same name.[3] Very often constructors and their customers manufacture outright forgeries to enable them to build unapproved projects. Salavat Plant of Technological Glass was building an indoor swimming pool that had been presented on paper as an industrial training centre.[1] The Ministry of Construction of the Georgian Republic erected a 14-storey administrative building, presenting it in the planning documents as an engineering workshop.[2] An investigation of the Construction Bank revealed that in 1971 over 600 construction organizations worked on 880 unapproved projects, almost entirely for administrative and recreational purposes.[3]

---

[1] A. Terent'ev, "Nol' tselykh shest' desiatykh," Oktiabr' (No. 7, 1971), pp. 155-69.

[2] Manoilo.

[3] Ibid.

J. Regular Underfulfillment of Plans

For all these reasons, in the 8th Five-Year Plan, 1966-1970, capital investment was underfulfilled by more than 30 billion rubles.[4] The actual cost of construction for the same period was 30 billion rubles higher than planned, without increase in the production capacity of the construction industry.[5] This led to underfulfillment of the state plan for commissioning new industrial projects and the production of many new industrial goods.[1] This systematic non-fulfillment of capital investment plans led to annual reductions, during the previous Five-Year Plan, in the number of major new projects to be built which had already been approved by the state plan. Their number was cut from the initial figure of 560 in 1968 to 400 in 1969, and 300 in 1970.[2] But even this drastic reduction did not secure necessary concentration of capital investment.[3]

---

[1] I. Ganichev, "Svoevremennyi vvod ob'ektov - glavnaia zadacha stroitelei," Ekonomicheskaia gazeta (No. 1, 1973), p. 11.

[2] F. Manoilo, "Vsemerno povyshat' effektivnost' kapital'nykh vlozhenii," Finansy SSSR (No. 8, 1972), pp. 3-14.

[3] Ibid.

[4] V. Tolpygin, "Kapital'noe stroitel'stvo v deviatoi piatiletke," Planovoe khoziaistvo (No. 1, 1972), pp. 42-47.

[5] Ibid.

At present the value of uninstalled industrial equipment amounts to more than 5 billion rubles. This figure is bound to be an underestimation because of the wide-spread practice in the Soviet Union of not listing uninstalled equipment, because this puts managers in an unfavorable light.[4] A large proportion of the blame for this situation is put on the construction industry because of its failure to meet deadlines.[5]

On June 20, 1969 Pravda published new directives issued by the Central Committee and the Council of Ministers of the USSR, where their concern was expressed over the existing situation in construction industry and new measures formulated to improve it.[1] Despite numerous positive responses to these directives in the press, the situation has not visibly improved. The construction industry was again strongly criticized at the 24th Congress of the CPSU in 1971. In March, 1972 General-Secretary of the CPSU L. I. Brezhnev in his speech at the 15th Congres of Soviet Trade Unions said the following:

---

[1] Ibid.

[2] A. Omarov, "Problemy povysheniia effektivnosti obshchestvennogo proizvodstva," Planovoe khoziaistvo (No. 11, 1971), pp. 61-71.

[3] Toplygin.

[4] See for instance "Vesti s mest," Izvestiia, March 2, 1972, p. 3, and "Materialam - tochnyi uchet," Izvestiia, April 13, 1972, p. 3.

[5] D. Allakhverdian, "O finansovykh problemakh devyatoi piatiletki," Voprosy ekonomiki (No. 11, 1971), pp. 3-14.

> The plan of commissioning new projects in 1971 was not fulfilled. The time of construction remains long. The proportion of the so-called "nezavershonki" [projects that have not been completed as required by plans] have even increased in comparison with 1970.[2]

According to 1972 press reports from construction sites, the situation remains basically the same.

Any prolongation in construction period for whatever reasons makes it more expensive, for a part of construction expenses is directly linked with the length of construction. Some 50 % of all current expenses depend on the length of construction.[3]

---

[1] "O sovershenstvovanii planirovania kapital'nogo stroitelstva i ob usilenii ekonomicheskogo stimulirovaniia stroitel'nogo proizvodstva," Pravda, July 20, 1969, pp. 1-2.

[2] "Rech' tovarishcha Brezhneva," Izvestiia, March 21, 1972, pp. 1-3.

[3] A. I. Shuster, Faktor vremeni v otsenke ekonomicheskoi effektivnosti kapital'nykh vlozhenii (Moskva: Izd-vo "Nauka", 1969), p. 37.

K. Slow Construction - a Brake on Technological Progress

Even more important is the acceleration of construction, from the point of view of the application of the achievements of science and technology. In planning future enterprises all construction and technological decisions are based on the existing results of science and technology. However, during the years of construction and reaching designed parameters, new advances are made in a given field that allow to develop new, more progressive and economic solutions which might make even relatively new products and technological processes outdated before the full return on investment, or in some cases before the beginning of industrial production. Therefore any lengthening in construction processes and achieving designed performance reduces the period of its efficient use.

L. Conclusion

In order to mass produce new technology, the construction of new plants and expansion of the existing ones is often required. Quick and high quality construction if often the key in producing new products before obsolescence sets in. However, the Soviet construction industry, judging by the numerous Soviet accounts, is failing in this respect very badly. The main reasons for the failure to meet deadlines are scattering of resources over excessive number of projects, faulty planning and designing of new projects, low labor productivity in the industry and redirection of the allocated resources for unapproved projects. Despite numerous expressions of concern by the Central Committee of the CPSU and the Council of Ministers of the USSR, the situation remains unimproved in this industry which plays such a key role in technological advances.

CHAPTER VIII

MANAGEMENT

When something goes wrong, Russians often use the old saying "The fish starts to rot from its head." Any discussion dealing with problems of Soviet industry is incomplete without at least briefly mentioning the problem of Soviet industrial management.

A. The Management Problem in Marxist Writings

Marx proposed his scheme of history when the typical production unit was a small firm. The idea of managing or coordinating human efforts toward the achievement of goals in complex organizations was out of place. For the Marxists before the October revolution the manager was just an exploiter and a parasite too, since he did little observable work. It appeared quite likely that the managers could be removed from the scene, with workers taking over industry.

B. Management Under Stalin

However, Soviet government soon learned that the problems of management were numerous and complex and required special, highly-qualified training and skill. Up to 1937, large numbers of treatises, both Soviet and others translated from foreign languages, appeared in the USSR. However, Stalin, perhaps regarding himself threatened by the growing managerial elite composed of well educated independent thinkers, purged the management too.[1] He evidently felt that a relatively small number of top politicians, central planners and administrators could make practically all decisions of consequence for the economy from the center. Managers were given mostly engineer's training rather than that of independently thinking, creative decision-makers.

The Soviets have benefitted very little from modern management methods and only in the last few years have they come to realize this major deficiency in their present system.

C. Soviet Industrial Management in New Conditions

By the mid-1950's it was becoming increasingly obvious that economic overcentralization was leading to great waste and inefficiency in the now complex Soviet economy. Since 1955, local managers have acquired greater authority and independence over the activities of their organizations and in the execution of their managerial activities. Because of their narrow technical training, predominately in engineering fields, many enterprise managers were not prepared to cope with their much enlarged duties. The enterprise manager was now in a position where he had to make substantially more independent decisions on more diverse matters than before in carrying out his functions. The problem of coordination became more complex as enterprises grew in size and acquired more complex technology. With greater labor mobility and a growing shortage of skilled labor, the direction and motivation of subordinates became more difficult.[1]

---

[1] Jeremy R. Azrael, Managerial Power and Soviet Politics (Cambridge, Massachusetts: Harvard University Press, 1966), pp. 95-102.

The Soviet economy was now also faced with an increasingly larger and more complex market structures than in the past. The input-output relationships among interdependent productive sectors of the Soviet economy also have become more complex and delicate in terms of product specifications and quality. It is true that important aggregate decisions with respect to market requirements are still made by higher level planners above the enterprise. However, enterprise managers now play a greater role in connection with their product mixes.

D. Inadequate Training

Education and training in economics and related business administration fields have been expanded and somewhat improved in recent years. Nevertheless, the Soviet educational system still does not produce all round, independently thinking, creative decision-makers and the production of narrow specialists who are trained primarily what to think rather than how to think can have adverse effect on future economic results, given the current stage of Soviet economic development. The manager in the Soviet Union is still seen as a subordinate whose main requirement is the ability to carry out assignments.[2] What is even more strange is that despite great achievements of the Soviet educational system, the situation with the educational level of managers of industrial enterprises is still somewhat below what one would have expected. According to Soviet data, five years ago managers with higher and secondary education represented 68 % of the total[1] - which means that nearly one third of all industrial managers did not have even a secondary education.

---

[1] Barry M. Richman, Soviet Mangement (Eaglewood Cliffs, N.J.: Prentice-Hall, Inc., 1965), pp. 228-252.

[2] S. Korolev and A. Gorbovskii, "Znat' i umet'," Izvestiia, June 29, 1972, p. 5.

Undoubtedly this situation is a result of a strong belief in the USSR that managerial skills can be developed and the art of management perfected only through experience. It is also the result of the traditional Soviet reluctance to fire men who, although lacking formal education, nevertheless have performed for years quite satisfactorily.

E. Low Prestige of Soviet Managers

On the other hand, because of the faulty planning and unreliable supply system managers often have to get involved in rather quasi-legal operations that tarnish their image. While in the West a managerial job is one of the most desired occupations, in the Soviet Union this position is very low in the eyes of many people and especially among the young. A survey carried out by a group of sociologists of the Perm' Polytechnical Institute has found that of 23 professions given to engineers, workers and office workers, the prestige of ordinary engineer was put at the seventh place, while that of a manager at the fourteenth.[1] Similar results have been produced among students and graduates - managers always trail far behind engineers in prestige.[2] Research results at one plant showed that almost one half of the young managers either had no aspiration for this type of work or had become managers contrary to their own wishes.[3]

---

[1] P. Oldak and V. Grober, "Vuz: shirokie dveri i tesnye stupeni," Literaturnaia gazeta, October 18, 1972, p. 10.

There is no doubt that it is the poor management which is largely responsible for the Soviet worker's labor productivity being only one half of that of the American worker, while 4,300 qualified engineers are engaged in the production of one billion ruble-worth of industrial output in the USSR against only 1,200 engineers in American industry employed in producing the same amount of products.[4]

F. Conclusion

There is a great difference between the function of the manager in the West and in the Soviet Union. While in the West he is well educated, independent decision-maker, the main quality of the Soviet manager is his ability to carry out orders. Soviet authorities are fully aware of the inadequacies of this type of management and certain steps are being taken to improve managerial training and the authority of managers. The Soviet press is full of calls for more initiative, boldness and imagination on the part of management, but judging by the persistence of this topic in Soviet discussions, Soviet managers still lack the above mentioned qualities. The present role of the Soviet manager is determined by the very nature of the Soviet economic system and the arbitrary distribution of blame and punishment of those who have diverged from the orders from above and got into difficulties.[1] Introduction of new technology is often accompanied by risk-taking and requires knowledge of the market situation, initiative, and imagination - the qualities that do not distinguish the Soviet management.

---

[1] E. Fainburg, "Razgovor o prestizhe upravlencheskikh professii," Literaturnaia gazeta (No. 29, 1971), p. 10.

[2] Ibid.

[3] S. Korolev and A. Gorbovskii.

[4] O. Volkov, "Avtomatizatsiia i razvitie proizvodstva," Voprosy ekonomiki (No. 3, 1972), pp. 50-57.

In conclusion one might say that the quality of the Soviet manager goes a long way towards explaining Soviet difficulties in introducing and assimilating new technology.

---

[1] For a discussion of this problem see Joseph S. Berliner, Factory and Manger in the USSR (Cambridge: Harvard University Press, 1957), pp. 44-56. It is also touched by L. Brezhnev in his speech at the 24th Congress of the CPSU - see Materialy XXIV s'ezda KPSS, p. 65.

SUMMARY

The Soviet Union is the second economic power in the world. However, its main ambition - to become the leading economic and technological power - has been frustrated because the economic system, one which has been credited with the high rates of economic growth in the past proves to be a not very effective mechanism for the present highly complicated Soviet economy. The Soviet government is aware of the problems facing the national economy and has tried a number of reforms to improve the situation. But the impact of these reforms has been very modest because they were only half-measures and the Soviet leadership is apprehensive that far-reaching economic reforms could cause serious political and sociological changes which might undermine the power of the Communist party. In view of this, the main emphasis is put on a rapid assimilation and dessimination of new technology which the government hopes, will not affect its rule.

In order to facilitate the assimilation of new technology the government was willing to experiment with new forms of R & D. However in this area too, the high Soviet hopes have been frustrated because all the problems that adversely affect the performance of the economy as a whole - over-centralization, lack of cooperation between various ministries, production-orientation, inadequate incentives, arbitrary price structure - are present in R & D. The arrangements that produce the most encouraging results tend to work in an unorthodox manner (intermediate firms, for instance), and this is unacceptable to the authorities. When the Soviet leadership has a choice between greater economic benefit and a possibility of changes in society on one hand, and stability (even

though less economically successful) on the other, it picks the latter.[1] There is no doubt that there will be more experiments with new forms of economic activity. Nevertheless, the party's determination not to weaken its all-embracing control and to maintain the cohesion and stability of the society will render them less than a success.

In this connection it is interesting to speculate on the latest trend in Soviet economic thinking. The Soviet Union is putting at present a great emphasis on scientific, technological and economic co-operation and co-ordination with other developed countries. The current hunt for new technology abroad is the greatest since the First Five-Year Plan. It is somewhat puzzling because Soviet accounts suggest that the problem is not the lack of new technology but the inability of the system to assimilate and dessiminate it. It could be that the Soviet government is beginning to have second thoughts about the effectiveness of pumping ever-increasing amounts of money into national R & D and has come to a realization that being a more active and integrated member of the international community could benefit the country more than striving for maximum self-sufficiency while seeing the outside world in a purely negative light, as a world having only evil designs against the USSR.

---

[1] This point has been made by Michael Kaser, Soviet Economics (New York: McGraw-Hill Book Company, 1970), pp. 220-21.

BIBLIOGRAPHY

Books

Allakhverdian, D.A. *Khozraschet i upravlenie*. Moskva: Izd-vo "Ekonomika," 1970.

Artobolevskii, I. *Puti i razvitiia tekhniki v SSSR*. Moskva: Izd-vo "Nauka," 1967.

Azrael, Jeremy R. *Managerial Power and Soviet Politics*. Cambridge, Massachusetts: Harvard University Press, 1966.

Baibakov, N. K. (ed.). *Gosudarstvennyi piatiletnii plan razvitiia narodnogo khoziaistva SSSR na 1971-1975 gody*. Moskva: Izd-vo Politicheskoi literatury, 1972.

Belik, Iu. A. *Ekonomika SSSR v deviatoi piatiletke*. Moskva: Izd-vo "Znanie," 1971.

Berliner, Joseph S. *Factory and Manager in the USSR*. Cambridge: Harvard University Press, 1957.

Binshtok, F. *Nauka upravliat'*. Moskva: Izd-vo "Moskovskii rabochii," 1967.

Burks, R. V. "Technology and Political Change in Eastern Europe," *Change in Communist Systems*, ed. Chalmers Johnson, pp. 265-311. Stanford: Stanford University Press, 1970.

Campbell, Robert W. *Soviet Economic Power*. Boston: Houghton Mifflin Co., 1966.

Dobrov, G. M. *Naukovedenie prognozirovanie informatika*. Kiev: Izd-vo "Naukova dumka," 1970.

Dobrov, G. M. (ed.). *Potensial nauki*. Kiev: Izd-vo "Naukova dumka," 1969.

Dobrov, G. M. *Upravlennia naukoiu*. Kyiv: Izd-vo "Naukova dumka," 1971.

Gatovskii, L. M. *Problemy ekonomicheskogo stimulirovaniia nauchno-tekhnicheskogo progressa*. Moskva: Izd-vo "Nauka," 1967.

Golosovskii, S. I. *Effektivnost' nauki*. Moskva: Izd-vo "Ekonomika," 1969.

Gorfman, K. L., Komkov, N. I., and Mindeli, L. E. *Planirovanie i upravlenie nauchnymi issledovaniiami*. Moskva: Izd-vo "Nauka," 1971.

Joravskii, David. *The Lysenko Affair*. Cambridge, Massachusetts: Harvard University Press, 1970.

Judy, Richard W. "Information, Control and Computers in Soviet Economic Management" in Hardt, John P. et al. *Mathematics and Computers in Soviet Economic Planning*, pp. 1-67. New Haven: Yale University Press, 1967.

Kaser, Michael. *Soviet Economics*. New York: McGraw-Hill Book Company, 1970.

Krasovskii, V. P. *Planirovanie i analiz narodno-khoziaistvennoi struktury kapital'nykh vlozhenii*. Moskva: Izd-vo "Ekonomika," 1970.

Kuznetsov, I. N. *Proizvodstvennye ob'edineniia i effektivnost' proizvodstva*. Moskva: Izd-vo "Znanie," 1971.

Lebedev, V. G. *Narodno-khoziaistvennaia effektivnost' razvitiia tekhniki*. Moskva: Izd-vo "Mysl'," 1971.

Materialy XXIV s'ezda KPSS. Moskva: Izd-vo Politicheskoi literatury, 1971.

Meleshkin, M. T., Sidorov, A. P., and Chervenko, I. A. *Uskorenie osvoeniia moshchnostei v promyshlennosti*. Moskva: Izd-vo "Ekonomika," 1967.

Murphy, Thomas P. *Science, Geopolitics, and Federal Spending*. Toronto: D. C. Heath and Company, 1971.

My i planeta. Moskva: Izd-vo Politicheskoi literatury, 1972.

Nove, Alec. *The Soviet Economy*. New York: Frederick A. Praeger, Inc. Publishers, 1969.

Okpostvaridze, I. E. *Gosudarstvennyi biudzhet gruzinskoi SSR na sluzhbe nauki*. Tbilisi: Izd-vo "Metsniereba," 1970.

Oznobin, N. M., Rogov, A. I., and Klinskii, A. I. *Tekhnicheskii progress i planomernoe razvitie narodnogo khoziaistva*. Moskva: Izd-vo "Mysl'," 1971.

Pravovye voprosy nauchno-tekhnicheskogo progressa v SSSR. Moskva: Izd-vo "Iuridicheskaia literatura," 1967.

Problemy deiatel'nosti uchenogo i nauchnykh kollektivov. Leningrad: Izd-vo "Nauka," 1969.

Richmann, Barry M. *Soviet Management*. Eaglewood Cliffs, N. J.: Prentice-Hall Inc., 1965.

Shuster, A. I. *Faktor vremeni v otsenke ekonomicheskoi effektivnosti kapital'nykh vlozhenii*. Moskva: Izd-vo "Nauka," 1969.

Smyshliaeva, L. M. Struktura kapital'nykh vlozhenii i ikh fakticheskaia effektivnost'. Moskva: Izd-vo "Nauka," 1970.

Sorokin, G. M. and Alampiev, P. M. Problemy ekonomicheskoi integratsii stran-chlenov SEV. Moskva: Izd-vo "Ekonomika," 1970.

Sutton, Anthony S. Western Technology and Soviet Economic Development, 1917 to 1930. Stanford: Hoover Institution on War, Revolution and Peace, 1968.

Sutton, Anthony S. Western Technology and Soviet Economic Development, 1930 to 1945. Stanford: Hoover Institution on War, Revolution and Peace, 1971.

Tolkachev, A. S. Ekonomicheskie problemy material'no-tekhnicheskoi bazy kommunisma v SSSR. Moskva: Izd-vo "Mysl'," 1971.

Volkov, G. N. Sotsiologiia nauki. Moskva: Izd-vo Politicheskoi literatury, 1968.

Weidenbaum, Murray L. and Larkins, Dan. The Federal Budget for 1973. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1972.

Journal Articles

Abroskin, P. "Sovershennye mashiny - osnova tekhnicheskogo progressa," Kommunist (No. 1, 1965), pp. 46-55.

Allakhverdian, D. "O finansovykh problemakh deviatoi piatiletki," Voprosy Ekonomiki (No. 11, 1971), pp. 3-14.

Ambarzumov, A. "K voprosu o sovershenstvovanii planirovaniia kapital'nykh vlozhenii," Voprosy ekonomiki (No 2, 1971), pp. 118-23.

Andreev, V. and Kiperman, G. "Planirovanie i stimulirovanie tekhnicheskogo progressa," Voprosy ekonomiki (No. 1, 1972), pp. 69-78.

Artem'ev, E. and Kravets, L. "O merakh po uskoreniiu tekhnicheskogo osvoeniia nauchnykh dostizhenii," Planovoe khoziaistvo (No. 7, 1972), pp. 109- 17.

Bard, V. and Rybakova, R. "Effektivnost' kaptial'nykh vlozhenii i promyshlennosti i istochniki ikh finansirovaniia," Finansy SSSR (No. 2, 1972), pp. 46-51.

Bartol, Kathryn M. "Soviet Computer Centres: Network or Tangle?" Soviet Studies, 23 (April, 1972), pp. 608-18.

Becker, Abraham S. "Comparisons of United States and USSR National Output," World Politics, XIII (October, 1960), pp. 99-111.

Bergson, Abram. "Toward a New Growth Model," *Problems of Communism*, XXII (March-April, 1973), pp. 261-69.

Bunich, P. "Ekonomicheskoe stimulirovanie proizvodstva i novaia tekhnika," *Voprosy ekonomiki* (No. 10, 1972), pp. 15-25.

Efimov, K. "Puti uskoreniia nauchno-tekhnicheskogo progressa," *Voprosy ekonomiki* (No. 4, 1972), pp. 47-58.

Evropin, V. and Sapilov, E. "Kompleksno planirovat' nauchno-tekhnicheskii progress," *Planovoe khoziaistvo* (No. 6, 1971), pp. 3-12.

Garetovskii, N. "Finansy i nauchno-tekhnicheskii progress," *Finansy SSSR* (No. 2, 1971), pp. 27-40.

Gatovskii, L. "Ekonomicheskaia zainteresovannost' predpriiatii v novoi tekhnike," Voprosy ekonomiki (No. 2, 1972), pp. 6-19.

Gatovskii, L. "O kompleksnom upravlenii naukoi, tekhnikoi, proizvodstvom," *Kommunist* (No. 10, 1971), pp. 27-39.

Gliazer, L. "Ekonomicheskaia effektivnost' nauchnogo issledovaniia," *Planovoe khoziaistvo* (No. 9, 1971), pp. 45-53.

Gorbunov, E. "Tempy, uroven' i struktura proizvodstva SSSR," *Voprosy ekonomiki* (No. 3, 1971), pp. 41-51.

Greenberg, Linda Lubrano. "Soviet Science Policy and the Scientific Establishment," *Survey*, 17 (No. 4, 1971), pp. 51-63

Gribanova, O. "Ekonomicheskie problemy razvitiia nauki," *Voprosy ekonomiki* (No. 10, 1971), pp. 146-152.

Gromov, V. "Kontsentratsiia proizvodstva i sovershenstvovanie ego form," *Kommunist* (No. 17, 1971), pp. 44-55.

Igant'ev, A. A. "Nauka kak ob'ekt upravleniia," *Voprosy filosofii* (No. 11, 11, 1971), pp. 17-26.

"Interview with Defence Secretary M. Laird," *U.S. News and World Report*, March 27, 1972, p. 44.

Kassem, M. Sami, Maertin, Harvey, and Efroymson, John S. "Soviet and American Policies on Science and Technology," *Studies on the Soviet Union*, XI (No. 3, 1971), pp. 67-82.

Kazakevich, L. and Shishakov, V. "Ekonomichskoe sotrudnichestvo SSSR s sotsialisticheskimi stranami," *Narodnoe khoziaistvo* (No. 10, 1972), pp. 91-102.

Kedrova, K. "Uskorenie realizatsii nauchno-tekhnicheskikh dostizhenii," *Voprosy ekonomiki* (No. 7, 1972), pp. 50-61.

Khachaturov, T. "Povyshenie effektivnosti obshchestvennogo proizvodstva," Voprosy ekonomiki (No. 4, 1971), pp. 18-30.

Khromov, P. A. "Proizvoditel'nost' truda v narodnom khoziaistve," Voprosy ekonomiki (No. 1, 1971), pp. 132-134.

Kiperman, G. and Koshlich, B. "O fonde osvoeniia novoi tekhniki," Voprosy ekonomiki (No. 6, 1972), pp. 119-122.

Kirnarskaia, K. "Rezervy sokrashcheniia srokov i zatrat na osvoenie novoi tekhniki," Planovoe khoziaistvo (No. 11, 1971), pp. 84-87.

Klinskii, A. and Oznobin, N. "Intensifikatsiia obshchestvennogo proizvodstva," Voprosy ekonomiki (No. 6, 1971), pp. 27-38.

Kotanian, M. "Patenty, litsenzii i nauchno-tekhnicheskii progress," Planovoe khoziaistvo (No. 8, 1971), pp. 72-77.

Kotov, F. "Aktual'nye problemy deviatoi piatiletki," Voprosy ekonomiki (No. 4, 1971), pp. 31-44.

Kurakov, I. G. "Nauka i effektivnost' obshchestvennogo proizvodstva," Voprosy filosofii (No. 10, 1966), pp. 13-14.

Lessing, L. "Why the U.S.A. Lags in Technology," Fortune, LXXXV (April, 1982), pp. 69-73.

Malova, G. "Nauchno-tekhnicheskoe sotrudnichestvo SSSR so stranami SEV," Voprosy ekonomiki (No. 9, 1972), pp. 119- 24.

Manoilo, F. "Kapital'noe stritel'stvo i zadachi Stroibanka v novoi piatiletke," Finansy SSSR (No. 7, 1971), pp. 3-10.

Manoilo, F. "Vsemerno povyshat' ekkeftivnost' kapital'nykh vlozhenii," Finansy SSSR (No. 8, 1972), pp. 3-14.

Meyer, Herbert E. "Why the Russians are Shopping in the U.S.," Fortune, LXXXVII (February, 1973), pp. 66-71.

Moiseenko, G. M. "Intelligentsiia v sovremennom kapitalisticheskom obshchestve," Voprosy filosofii (No. 12, 1971), pp. 43-54.

Omarov, A. "Problemy povysheniia effektivnosti obshchestvennogo proizvodstva," Planovoe khoziaistvo (No. 11, 1971), pp. 61-71.

Osekin, A. "O sovershenstvovanii sistemy material'nogo pooshchreniia za razrabotki, sozdanie i osvoenie novoi tekhniki," Finansy SSSR (No. 8, 1971), pp. 30-35.

Pavitt, Keith, "Technology, International Competition and Economic Growth: Some Lessons and Prospectives," World Politics, XXV (January, 1973), pp. 183-205.

Pavliuchenko, V. and Pirogov, S. "Nauchno-tekhnicheskii progress i effektivnost' proizvodstva," Voprosy ekonomiki (No. 1, 1971), pp. 109- 20.

Pavlov, P. "Intensifikatsiia proizvodstva i trudovye resursy," Voprosy ekonomiki (No. 3, 1972), pp. 15-21

Rachkov, P. A. "Problemy effektivnosti nauki i sovremennyi period," Voprosy filosofii (No. 5, 1966), pp. 14-24.

"Rezervy na sluzhbu proizvodstvu," Planovoe khoziaistvo (No. 11, 1972), pp. 3-8.

Rumiantsev, A. "Problemy nauchnogo i tekhnologicheskogo progressa," Voprosy ekonomiki (No. 1, 1971), pp. 3-14.

Schroeder, Gertrude E. "Soviet Technology: System vs. Progress," Problems of Communism, XIX (September-October, 1970), pp. 19-30.

Shentov, V. "Nauchno-tekhnicheskii progress i khoziaistvennaia reforma," Voprosy ekonomiki (No.33, 1971), pp. 143- 46.

Sher, I. "Finansovye problemy kapital'nogo stroitel'stva v deviatoi piatiletke," Finansy SSSR (No. 2, 1972), pp. 53-63.

Sitarian, S. "Nekotorye finansovye problemy IX piatiletki," Finansy SSSR (No. 7, 1971), pp. 11-20.

Skopina, Z. and Fel'dman, J. "Finansovye metody stimulirovaniia nauchno-tekhnicheskogo progressa," Finansy SSSR (No. 4, 1971), pp. 50-55.

Szuprowicz, Bohdan O. "East Europe: The Search for Computer," East Europe, 21 (April, 1972), pp. 2-6.

Tasik, K. "Nauchno-proizvodstvennye ob'edineniia," Voprosy ekonomiki (No. 11, 1972), pp. 40-52.

Terent'ev, A. "Nol' tselykh shest' desiatykh," Oktiabr' (No. 7, 1971), pp. 155- 69.

Tolpygin, V. "Kapital'noe stroitel'stvo v deviatoi piatiletke," Planovoe khoziaistvo (No. 1, 1972), pp. 42-47.

"Uskorenie nauchno-tekhnicheskogo progressa - delo vsego naroda," Kommunist (No. 18, 1971), pp. 3-13.

Veger, L. "Ekonomicheskaia effektivnost' v usloviiakh neopredelennosti," Voprosy ekonomiki (No. 2, 1972), pp. 47-58.

Vermishev, K. "Stimulirovanie rosta naseleniia," Planovoe khoziaistvo (No. 12, 1972), pp. 102-107.

Volkov, O. "Avtomatizatsiia i razvitie proizvodstva," *Voprosy ekonomiki* (No. 3, 1972), pp. 50-57.

Zakharov, V., Medvedev, V., and Iashen'kin, N. "Nekotorye problemy stimulirovaniia tekhnicheskogo progressa," *Kommunist* (No. 4, 1972), pp. 41-50.

Zelenskii, G. and Voronin, E. "Trudovye resursy v deviatoi piatiletke," *Planovoe khoziaistvo* (No. 8, 1971), pp. 26-36.

Newspapers

Abramov, Y. and Proskuriakova, A. "Kak uchit' ekonomike," *Pravda*, July 18, 1971, p. 3.

Buderkin, P. "Effekt vnedreniia," *Izvestiia*, March 4, 1972, p. 3.

Bunkov, S. "Na tormozakh," *Izvestiia*, February 3, 1972, p. 3.

Churpita, V. "Ochevidnye minusy," *Ekonomicheskaia gazeta* (No. 2, 1973), p. 7.

Dmitriev, I. "Stroit' bystro, ekonomichno," *Pravda*, February 15, 1972, p. 2.

Editorial. *Pravda*, May 10, 1969, p. 1.

Editorial. *Pravda*, July 17, 1971, p. 1.

Fainburg, E. "Razgovor o prestizhe upravlencheskikh professii," *Literaturnaia gazeta* (No. 29, 1971), p. 10.

The Financial Times (London), October 10, 1970, p. 8.

Flegontov, G. "Rabotaet sektor effektivnosti," *Ekonomicheskaia gazeta* (No. 35, 1972), p. 7.

Foniakov, I. "Pochemy zatukhaet "Fakel?" *Literaturnaia gazeta* (No. 26, 1970), p. 10.

Frolov, A. "Moshchnosti na bumage," *Izvestiia*, July 18, 1972, p. 3.

Ganichev, I. "Svoevremennyi vvod ob'ektov - glavnaia zadacha strotelei," *Ekonomicheskaia gazeta* (No. 1, 1973), p. 11.

Gerbachevskii, V. "Vol'demar Bush ukhodit," *Literaturnaia gazeta* (No. 5, 1973), p. 10.

Golembiovskii, I. "Formula Busha," *Izvestiia*, January 26, 1972, p. 3.

Kapitsa, A. "Proizvoditel'nost' truda uchenykh," *Komsomol'skaia pravda*, January 20, p. 3.

Kashutin, P. "Sodruzhestvo nauki i proizvodstva," *Ekonomicheskaia gazeta* (No. 52, 1972), p. 15.

Kolosov, A. and Lipatov, V. "Vnedrenie goluboi mechty," *Literaturnaia gazeta* (No. 25, 1971), p. 11.

Kolotyrkin, Y. "Novoe v oplate truda uchenykh," *Pravda*, March 25, 1969, p. 3.

Komov, V. "Vereteno v parke," *Izvestiia*, June 8, 1972, p. 3.

Korolev, S. and Gorbovskii, A. "Znat' i umet'," *Izvestiia*, June 29, 1972, p. 5.

Lavrinovich, M. and Gurus, I. "Dokazano na praktike," *Pravda*, January 15, 1972, p. 3.

Levin, A. "Kak rozhdaetsia sistema," *Pravda*, July 30, 1971, p. 3.

Maksarev, Y. "Puti vnedreniia tekhnicheskogo progressa," *Ekonomicheskaia gazeta* (No. 26, 1970), p. 5.

Maksarev, Y. "Vazhnoe zveno tekhnicheskogo progressa," *Pravda*, June 30, 1969, p. 3.

Margolit, R. "Zavodskaia mimikriia," *Literaturnaia gazeta* (No. 25, 1971), p. 11.

"Materialam-tochnyi uchet," *Izvestiia*, April 13, 1972, p. 3.

Mironov, N. "Staraia model'," *Pravda*, July 14, 1971, p. 3.

Mishstin, D. "Ischesla ne odna laboratoriia," *Ekonomicheskaia gazeta* (No. 37, 1972), p. 5.

Molchanov, A. "Novoe vo vnedrenii novoi tekhniki," *Ekonomicheskaia gazeta* (No. 47, 1966), p. 16.

Mozhnin, V. "Skol'ko stoit eksperiment," *Izvestiia*, March 26, 1972, p. 3.

Murarka, Dev. "More Heads to Roll in Russian Farm Crisis," *The Observer*, February 4, 1973, p. 5.

Novikov, I. T. "Stroit' bystree i ekonomichnee," *Pravda*, August 15, 1972, p. 2.

Oldak, P. and Grober, V. "Vuz: shirokie dveri i tesnye stupeni," *Literaturnaia gazeta*,(October 18, 1972), p. 10.

Orechkin, D. "Zavodskoi forpost nauki," *Izvestiia*, October 21, 1972, p. 1.

"O sovershenstvovanii planirovaniia kapital'nogo stroitel'stva i ob usilenii ekonomicheskogo stilulirovaniia stroitel'nogo proizvodstva," Pravda, July 20, 1969, pp. 1-2.

Popov, G. "Reforma u dverei instituta," Pravda, August 15, 1968, p. 2.

Poshataev, B. and Poshekhonov, Y. "Rabochii den' uchenogo," Pravda, February 6, 1969, p. 2.

"Rech' tovarishcha Brezhneva," Izvestiia, March 21, 1972, pp. 1-3.

Seidov, G. "Stanovlenie proizvodstvennykh predpriiatii," Ekonomicheskaia gazeta (No. 51, 1972), p. 14.

Shashmin, I. "Predpriiatiiam - kadry issledovatelei," Pravda, January 9, 1966, p. 2.

Sitnin, V. K. "Tekhnicheskii progress i tsenoobrazovanie," Ekonomicheskaia gazeta (No. 32, 1972), p. 7.

Smirnov, V. "Soiuz laboratorii i tsekha," Izvestiia, March 23, 1972, p. 2.

Sominskii, V. "Ekonomika nauchnykh issledovanii," Ekonomicheskaia gazeta (No. 10, 1967), p. 7.

"Soviet Bolster Agriculture," Edmonton Journal, October 23, 1972, p. 53.

Strazhev, A. "Ot idei do konveiera," Pravda, July 5, 1971, p. 2.

Szulc, Tad. "Nixon Signs Bill on Arms Accord," New York Times, October 14, 1972, p. 10.

Trapeznikov, V. "Effektivnost' nauki," Pravda, January 18, 1967, p. 3.

Tselikov, A. I. "Konstruktor i tempy ekonomicheskogo progressa," Ekonomicheskaia gazeta (No. 4, 1973), p. 5.

Tuchkevich, V. "Ot idei do konveiera," Izvestiia, January 7, 1972, p. 2.

"Vesti s mest," Izvestiia, March 2, 1972, p. 3.

Vikhliaev, A. "Uroven' rentabel'nosti," Ekonomicheskaia gazeta (No. 30, ~~1970), p.~~ 17.

Volin, P. "Khikmet - eto znachit mudrost'," Literaturnaia gazeta (No. 24, 1971), p. 10.

Zapisov, M. "Nauchno-proizvodstvennye ob'edineniie: opyt i problemy," Ekonomicheskaia gazeta (No. 7, 1973), p. 8.

Zhimerin, D. and Miasnikov, V. "Industriia upravleniia," Izvestiia, October 2, 1971, p. 2.

Encyclopedias

"Kibernetika," *Malaia Sovetskaia Entsiklopediia*, 1955, p. 219.

Schmookler, Jacob. "Industrial Research and Development," *International Encyclopedia of the Social Sciences*, 1968, XIII, pp. 483-486.

Documents

Narodnoe khoziaistvo SSSR v 1969 g. Moskva: Izd-vo "Statistika," 1970.

Narodnoe khoziaistvo SSSR v 1970 g. Moskva: Izd-vo "Statistika," 1971.

Narodnoe khoziaistvo SSSR, 1922-1972. Moskva: Izd-vo "Statistika," 1972.

UNESCO. *Statistical Yearbook, 1971*.

U.S. Congress, Joint Economic Committee. *Economic Performance and the Military Burden in the Soviet Union*. 91st Cong. 1st sess. 1970.

U.S. Congress, Joint Economic Committee. *New Directions in the Soviet Economy*. 89th Cong. 2nd sess. 1966.

Radio Programs

The Voice of America, October 22, 1972.

The Voice of America, October 4, 1972.

APPENDIX I.

Industrial Research and Development (R & D)

"Research describes the quest for new scientific or engineering knowledge and development refers to the creation and the reduction to practice of new products or processes... The word order of the phrase may convey the impression that scientific or engineering discovery invariably precedes development, but development often leads to new discovery or occurs without it."

Source: Jacob Schmookler, "Industrial Research and Development," International Encyclopedia of the Social Sciences, 2nd ed., 1968, Vol. 13, pp. 483-86.

APPENDIX II.

"Who is a Scientist?"

An Official Soviet Definition.*

Scientific workers (nauchnye rabotniki) include Academicians, Full Members and Corresponding Members of all academies; all persons having the degree of doctor of science, candidate of science or the scientific title of professor, docent, senior research worker, junior research worker, assistant, irrespective of the place and character of their work; persons carrying out research work in scientific institutions and research and teaching work in institutions of higher learning, irrespective of whether they hold a scientific degree or not, and also specialists without scientific degree or scientific title, carrying out research work at industrial enterprises and in design organizations.

*Source: Narodnoe khoziaistvo SSSR v 1969 g. (Moskva: Izd-vo "Statistika," 1970), p. 829.

APPENDIX III.

TRANSLITERATION

А а	- a
Б б	- b
В в	- v
Г г	- g
Д д	- d
Е е	- e
Ё ё	- e
Ж ж	- zh
З з	- z
И и	- i
Й й	- i
К к	- k
Л л	- l
М м	- m
Н н	- n
О о	- o
П п	- p
Р р	- r
С с	- s
Т т	- t
У у	- u
Ф ф	- f
Х х	- kh
Ц ц	- ts
Ч ч	- ch
Ш ш	- sh
Щ щ	- shch
Ъ ъ	- '
Ы ы	- y
Ь ь	- '
Э э	- e
Ю ю	- iu
Я я	- ia